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CONTENTS

The Cultural Factor in the Dental Curriculum: PROFESSOR EDWARD C. KIRK 481

The Problem of the Assistant Professor: PROFESSOR GUIDO H. MARX 488

Scientific Notes and News 497

University and Educational News 500

Discussion and Correspondence:—
Fracastorius, Athanasius Kircher and the Germ Theory of Disease: DR. FIELDING H. GARRISON. *The Lower Tertiaries of Louisiana:* DR. G. D. HARRIS. *The Length of Service Pensions of the Carnegie Foundation:* PROFESSOR WM. HERBERT HOBBS 500

Scientific Books:—
Kastle on the Oxidases and other Oxygen Catalysts concerned in Biological Oxidation: PROFESSOR W. H. HOWELL. *Lowell on the Evolution of Worlds:* PROFESSOR CHARLES LANE POOR. *Turner on Aerial Navigation of To-day:* PROFESSOR A. LAWRENCE ROTCH 504

Scientific Journals and Articles 508

Reflections on Joly's Method of Determining the Ocean's Age: DR. GEORGE F. BECKER .. 509

Botanical Notes:—
Recent Studies of the Fungi; Nomenclature of the Fungi; Descriptive Botany of the Flowering Plants: PROFESSOR CHARLES E. BESSEY 512

Special Articles:—
The Sex-determining Chromosomes in Ascaris: PROFESSOR CHARLES L. EDWARDS ... 514

The American Federation of the Teachers of the Mathematical and Natural Sciences: PROFESSOR C. R. MANN 515

The American Association of Economic Entomologists 516

Societies and Academies:—
The Geological Society of Washington: EDSON S. BASTIN, FRANÇOIS E. MATTHES. *The Biological Society of Washington:* D. E. LANTZ. *The American Chemical Society, New York Section:* C. M. JOYCE. *The Chemical Society of Washington:* J. A. LECLERC 516

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THE CULTURAL FACTOR IN THE DENTAL CURRICULUM[1]

FIRST of all let me discharge the pleasurable duty imposed upon me by the administration of the University of Pennsylvania and its faculty of dentistry, by conveying to you their fraternal greetings and hearty congratulations upon the completion of this splendid edifice which to-day you dedicate to the purposes of education in an important specialty of the science and art of healing.

It is characteristic of the things of the mind that they are unhampered by the limitations of time or extent, that the commonwealth of intellect is without geographical boundaries or distinctions of caste, race or nationality; that the pursuit of the intellectual ideal lifts all to the level of a common brotherhood; and it is in the spirit of this larger fraternalism that I bring you the salutations and greetings of one of the oldest institutions of learning established by England in her American colonies. It is by reason of our common origin as well as by reason of our common ideal that I have a peculiar pleasure in being present upon this happy occasion as the temporary mouthpiece of an elder sister institution to discuss with you briefly something of the circumstances and conditions which environ the special department of education with which we are mutually concerned, and, claiming the prerogative of an elder sister somewhat, to point out a few of the difficulties to be overcome by her younger

[1] Delivered at the dedication of the new building of the Royal College of Dental Surgeons, Toronto, December 29, 1909.

relative who, with the enthusiasm and pride begotten of a new and faultless dress, starts out to-day refreshed and eager upon her educational pathway.

While dentistry and possibly dental education, in some sort or degree, is doubtless coeval with man and man's physical needs, dentistry as an organized department of activity and education is but seventy years old, its inception as a profession dating from the establishment of the first school for the systematic education of dental practitioners in Baltimore in 1839. From this initial and successful attempt at organization upon an educational basis have arisen all subsequent efforts having the same objective purpose, notwithstanding the individual differences as to means and methods which they severally involve.

From the first successful attempt to provide the means for the systematic education of the dentist down to the present time both the effort and its practical realization have been "hedged round and about" by opposing opinions as to the relationship which dental education should rightfully bear to medical education. And while the arguments of those who would compel the merging of dental education within the medical curriculum are even now manifesting another periodical recrudescence, the process of evolution and the incontestable logic of fact and experience are more and more firmly establishing dental education upon an autonomous basis.

It is not my purpose to enter into a discussion of the relationships of dentistry and medicine further than to call attention to the fact that from its beginnings as an educational system dental education has been subject to more or less stress of criticism because it has elected to develop outside of the channels of medical education and to mark its qualification with a degree distinctive of its own special culture.

That our professional forebears were wise in their decision to place dental education upon an independently organized basis is a conclusion which I think is justified by the practical success of their plan, which in its evolution and development has given to the world the profession of dentistry as we now find it ministering acceptably to the health and comfort of humanity in all civilized nations.

The social conditions, the social needs of humanity to-day, are, however, not the same as those which characterized the period when dentistry as a profession was in its swaddling-clothes. To quote a recent phrase of President Eliot, "the world has been remade in the last half century," and it will, I think, be profitable for us to consider to what degree dentistry and dental education have kept pace with this world development; in other words, has dentistry remade itself in keeping with the intellectual and material progress of society?

Mr. Herbert Spencer enunciated as his broadest and most comprehensive definition of life that it is "the continuous adjustment of internal relations to external relations." Applying this definition to the case in hand, our inquiry concerns the degree and extent of the adjustment which dental education has maintained with respect to its environing social relations; has it in its educational methods reflected the intellectual progress of the times and fairly met the demands of the social order by a continuous adjustment thereto, thus demonstrating its right to live?

From the material point of view no other than an affirmative answer is possible. When we consider the aggregate of pain and suffering that has been mitigated or completely banished by the skillful ministrations of the dental practitioner, when we think of the added years of comfortable human life, the relief of distress from dis-

figurement, the restoration of comeliness, the prevention of disease, the correction of deformities and of defective speech and, above all, the boon of surgical anesthesia given to humanity by dentistry, surely no one can doubt its importance and utility as a department of the great science and art of healing.

In its technical procedures and its artistic craftsmanship dentistry has acquitted itself so creditably that the flexibility of its technical resourcefulness has become proverbial, yet to such an extent has the attention of the dental profession been focused upon the material side of its progress that we have failed, I fear, in no small degree, to grasp its larger possibilities and to appreciate the importance of those factors of professional life upon which a higher attainment, a greater usefulness to humanity and a wholesome self-respect depend.

As a counter influence to this concentration of attention upon the material features of dental practise with its commercializing tendencies there is needed above all things an aggressive propaganda of education the objective purpose of which shall be the development of that type of culture which is expressed as professional character. In making this statement I fully realize that I am simply rephrasing a belief which has been frequently expressed before, but because of that very fact it is all the more evident that it represents a condition broadly recognized both within and without the limits of the dental profession.

A tendency to indifference toward those things which make for professional character has subjected us of the dental profession to not infrequent criticism, and some who recognize the condition without investigation of the cause are inclined to place the responsibility directly upon our dental educational institutions. That our dental colleges should become the target for criticism of that character is not unnatural, nor do I think that it is altogether unmerited.

As the seed ground for the development of professional skill and qualification through training and technical education, so also the colleges of dentistry should be the nurseries of professional character and culture. I take it for granted that there can be no dissension as to the general truth of that question, nor do I think that there can be any real doubt as to the fact that while we have given much attention to his technical education at all points, there has not been given proportionate attention to the cultural features of our educational system in the preparation of the student for his professional life.

It is in his college course and because of his college course that the student acquires and later manifests as a practitioner that tendency to concentrate his attention upon the material features of his work which I have before referred to as a professional attribute which gives rise to adverse criticism and creates the demand for a broader training for the dentist, less narrowing and commercializing in its tendency.

The general answer of our dental educational institutions to this kind of criticism is that they are purely technical schools, that they are compelled to deal with the material delivered to them by the preparatory schools, that defects in intellectual culture are chargeable to faulty preparation, that the business of the dental college is to teach dentistry, not to develop culture. This defensive attitude is only partially true, for while we may concede that the preliminary education of the dental student should have done much to broaden his mind and to have aroused to activity in him those intellectual attributes which later become fixed

in character, it must be remembered that the process has only been begun in the preparatory school and that three or four years of purely technical professional study may quite easily neutralize the cultural effect of his preparatory work unless his professional training is conducted with reference to conserving and further developing his powers of intellectual growth.

I realize full well that I am likely to arouse an attitude of incredulity, even possibly of scorn, by the suggestion that anything in the curriculum of dental study may have a cultural value as such, quite apart from its material technical usefulness; but because I believe that something more than mere technical training can be gotten out of the dental course, that something in the nature of character development may be derived from doing the work of the dental curriculum, I am encouraged to present that side of the question, for I am convinced that its due recognition will eventuate not only in relieving those of us who are teachers of a source of criticism, but also it will greatly improve the grade and texture of our educational product and make our graduates not only better dentists but men of larger intellectual resources and therefore more acceptable members of society.

Can the dental curriculum be utilized for the attainment of these desirable ends? Let us seek the answer in an analogy. It may be stated almost axiomatically that in the materialization of great artistic conceptions the character of the medium in which they may be expressed is a minor consideration. What concerns us most in the contemplation of a statue, for example, is not the material of which it is made, but is it good art, does it bear the stamp of artistic genius? The creations of the greatest masters of harmony were in many cases interpreted upon instruments of inferior grade, but the soul of music may speak its divine message through any medium, and enthralled by its spell, we care not if it be "blown through brass or breathed through silver." So also in the utilization of education for the ends of culture it is not the means by which the intellectual activities are set in motion that are of primary importance, but rather the ends toward which our educational efforts are directed, and it is these that should mainly concern us both as teachers and as students.

Education dominated by the purely utilitarian *motif,* as most of our modern education is, loses its cultural effect by concentrating the mental faculties upon the function of acquisition, of getting, as an intellectual process. The graduate thus trained goes forth to his life work, which consists for the most part in converting his mental potential into terms of material possession.

By the overemphasis of the utilitarian ideal those faculties of the mind, the exercise of which creates a taste for the higher orders of intellectual enjoyment, suffer from arrest of development, under which conditions any process of thought that does not work out to a concrete material end becomes impossible.

In this way we are not only creating a deformed and one-sided educational product, but still worse, we are closing the doors that lead to the sources of highest human happiness. The age is essentially utilitarian, the demand is for the practical and for the kind of education which may be ultimately expressed in terms of material prosperity. In response to the universal clamor for an education that will help to achieve these material ends, our schools, our seats of higher learning, are yielding, many of them under protest, to the general demand. The old and one-time popular type of education, the study of Greek and

Latin classics, is becoming obsolete and the demand is that modern language training shall replace the study of Greek and Latin because of the greater usefulness of modern languages in the practical business of life. Regarded simply as mental discipline the exchange of modern language study for the ancient tongues may have entailed no serious loss, and possibly, from the standpoint of material usefulness, the exchange may have even been attended with a certain degree of gain, but what has been lost is the uplifting effect of the Greek ideal, the spiritualizing power with which the activities of life became invested by contact with Greek thought and culture.

In his portrayal of the processes of intellectual growth of his young hero, Walter Pater says of Marius the Epicurean:

> He was acquiring what is the chief function of all higher education to impart, namely, of so relieving the ideal or poetic traits, the elements of distinction in our everyday life—of so exclusively living in them—that the unadorned remainder of it, the mere drift and débris of our days, comes to be as though it were not. . . . If our modern education in its better efforts really conveys to any of us that kind of idealizing power it does so (though dealing mainly, as its professed instruments, with the most select and ideal remains of ancient literature) oftenest by truant reading.

We have here, I think, the admission by one who was himself one of the illuminati of classic learning that while the "most select and ideal remains of ancient literature" are the professed instruments by which the idealizing power is directly awakened in the human intellect, yet the divine spark of inspiration is oftenest caught from "truant reading." But why necessarily or exclusively from reading of any sort in the literal sense? Is there not in the world about us, in the study of the material universe of which we are a part, the contact with which involves not only our struggle for existence but our effort to solve the riddle of life, the stuff from which all books, all literatures are derived? Is it not from these sources that the poets, the sages, the inspired ones of all times have heard the divine message and transmitted it in immortal terms to humanity?

Those leaders of education who have yielded a willing ear to the general demand for utilitarianism as the dominating principle in our educational system, have justified their position by a narrow interpretation of Herbert Spencer's epoch-making question of "What knowledge is of most worth?"

The deduction that only the knowledge which has any worth at all is that kind which may be converted to material use is an injustice to the intellectual breadth of the great philosopher which is not warranted by his own statement of his case. In his contention as to the superiority of scientific study over other means of education he says:

> The discipline of science is superior to that of ordinary education because of the religious culture that it gives. So far from science being irreligious, as many think, it is the neglect of science that is irreligious. Science is religious inasmuch as it generates a profound respect for and an implicit faith in those uniform laws which underlie all things. By accumulated experiences a man of science acquires a thorough belief in the unchanging relations of phenomena, in the invariable connection of cause and consequence, in the necessity of good or evil results. He sees that the laws to which we must submit are not only inexorable but beneficent. He sees that in virtue of these laws, the process of things is ever toward a greater perfection and a higher happiness. Science alone can give us true conceptions of ourselves and our relation to the mysteries of existence. Only the sincere man of science—and by this title we do not mean the mere calculator of distances, or analyzer of compounds, or labeler of species; but him who through lower truths seeks higher and eventually the highest—only the genuine man of science, we say, can truly know how utterly beyond not only human knowledge but human

conception is the universal power of which nature, and life and thought are manifestations. For discipline as well as for guidance, science is of chiefest value. In all its effects, learning the meaning of things is better than learning the meanings of words. Whether for intellectual, moral, or religious training, the study of surrounding phenomena is immensely superior to the study of grammars and lexicons.

In the passages which I have just quoted it seems to me we may find the vitalizing thought which honestly and intelligently applied to our educational work should ultimately lift it out of the slough of unrelieved materialism in which it is at present struggling, and help us to reform it upon lines which shall restore to all education the power to direct the mind toward the contemplation of higher things and thus to elevate the standards of reasonable human living and of human happiness.

Herbert Spencer, an accepted exponent of scientific thought, tells us that we must seek the higher truths through the lower orders of phenomena, which is simply the unadorned statement of an evolutional law, but a law which is the basis of all development of the mind, of all intellectual progress. Ages before anything worthy the name of science was conceived of, the mind of man in its earliest gropings took its first wavering steps toward the infinite through the labyrinth of common things about him, and out of his material experiences he began to weave the fabric of an intellectual vestment which was later destined to clothe his conception of his gods and his holy ones, and thus make it possible for him to worship the infinitely good, the true and the beautiful. And so it has been in all ages, for while we recognize the fact that each age refines and improves upon the experiences of its predecessors, yet the individual in his mental and cultural growth repeats the old journey, more easily perhaps, but nevertheless he must gain his goal by experiences concerned with the lower orders of truth before he can reach the higher. The poets, philosophers and artists of all times have reflected the same thought. If I catch his meaning aright it is a portrayal of this fundamental principle which we find set forth by Robert Browning, in that confession of his faith entitled "Christmas Eve and Easter Day," where he breaks forth in that magnificent declaration of the apotheosis of the love element in life—

Love which, on earth, amid all the shows of it,
Has ever been the sole good of life in it,
The love ever growing there spite of the strife in it,
Shall arise, made perfect, from Death's repose of it;
And I shall behold thee face to face,
O God, and in thy light retrace
How in all I loved there, still wast Thou.

It was the reaching out for these higher conceptions that characterized the best culture of the ancient Greeks, and conversely it is our tendency to subordinate these higher attributes of the mind in relative importance as compared with materialism and utilitarianism that is the defective feature of our modern systems of education. In our efforts to adapt education to the ends of material progress we have lost sight of the possibility, nay more, we have neglected the duty, of seeking for the higher orders of truth through the lower orders of phenomena with which we deal in our educational work. We have concentrated our attention too much upon the media of education and have in so doing neglected the most important ends of education, the cultivation of those higher attributes of character that satisfy the demand for happiness, that make life a joy well worth the living.

If such character development as produced the best culture of the Greeks were possible under the conditions of human knowledge and material development then

existing, how much simpler and more direct should be the access to a similar cultural development under the conditions of our modern civilization.

Our failure to discover the cultural value of the educational material with which we are now dealing has resulted from our intense preoccupation with the lower orders of phenomena and our consuming desire to utilize them for the ends of material prosperity.

We must reestablish the ancient ideal, which the best culture of all peoples has shown to be the development of an appreciation for the higher orders of truth, a love for the study of causes behind phenomena, and an abiding faith in the fact that the larger happiness of life is to be found in the things of the mind rather than in material acquisitions.

It is this ideal which must govern us as teachers if we are to hope to in any degree stem the tide of materialism and commercialism with which our work is at present dominated. We must realize that the work of the classroom and the laboratory is susceptible to the vitalizing influence of the cultural principle. To bring out from the study of the lower orders of phenomena with which he deals, an appreciation of the underlying forces, the *Weltgeist* of which the material things of life are but the outer cloak, is the mark of the true teacher as distinguished from the novice, just as it is the same order of intellectual development in the laboratory, the studio or the shop that marks the difference between the master and the apprentice, the artist and the artisan respectively.

I believe that the principle which I have thus attempted to portray is directly applicable to the work of the dental curriculum, as it is to all education. Dentistry in its scientific aspect may be regarded as a special department of the great science of biology combined with certain phases of chemistry and physics. Its art is merely the application of these sciences to the ends of practise, but in their practical application the cultural elements of honesty of purpose, faithfulness to artistic ideals, a love of the intrinsic beauty of nature's designs and a veneration for nature's laws are essentials for success. These higher cultural attributes it should be the part of the teacher to develop from the study of the data which comprise the lower order of phenomena of the dental curriculum.

To all who sympathetically and intelligently give ear to the voice of nature the pathway is clear, for, as Robert Louis Stevenson has beautifully expressed it:

> The Greeks figured Pan, the god of nature, now terribly stamping his foot, so that armies were dispersed; now by the woodside on a summer noon trolling on his pipe until he charmed the hearts of upland ploughmen. And the Greeks in so figuring uttered the last word of human experience. To certain smoke-dried spirits, matter and motion and elastic ethers and the hypothesis of this or that spectacled professor tell a speaking story; but for youth, and all ductile and congenial minds, Pan is not dead, but of all the classic hierarchy alone survives in triumph; goat-footed, with a gleeful and an angry look, the type of this shaggy world; and in every wood, if you go with a spirit properly prepared, you will hear the note of his pipe.

Our mission then as teachers of a humane and useful profession is to penetrate this "shaggy coat" of materialism, this commonplace and unattractive covering of the divine spirit behind it all, and to so educate those committed to our charge that they shall, in God's providence, be able to see something more than "the seamy side of the divine vestment which the earth-spirit is forever weaving on the whirling loom of time."

EDWARD C. KIRK

THE PROBLEM OF THE ASSISTANT PROFESSOR. III

PART II

The foregoing part represents the problem as seen from one point of view. It is therefore partial, incomplete. For the sake of completeness, a questionnaire (Appendix B) was prepared and sent to the presidents of the twenty-two institutions. The queries were drawn up for the purpose of showing, if possible, some of the broader movements which have affected and are affecting the status of the assistant professor, and also to get light from the administrative standpoint on the lower and upper limits of requirements for the position, etc.

An unfortunate clerical error, discovered too late for correction, called for data concerning students and staff for the years 1890–1 and 1900–1, instead of 1899–1900 and 1909–10. This was kindly remedied in some of the replies; while it was possible from other data available partially to remedy the error in a few other cases. It is greatly to be regretted that but ten practically complete replies had been received when the time for compilation arrived. It is obvious, for instance, that the present actual average salary of the assistant professor in these institutions could have been obtained (and used as a check on the result in Part I., as to whether the replies came from typical representatives of the rank), if answers had been received from each institution as to the number of assistant professors and the average salary. Because of partial answers, the showing of growth of student body and staff must also be omitted. The general trends of these are too well known to need demonstration here. The following table (VII.) has been compiled, however, from the data at hand, to show the change in the proportionate composition of staff which has taken place in the past twenty years.[9]

It is seen that while the assistant professors have formed a practically constant or slightly increasing proportion of the entire staff, the proportion of the staff above

TABLE VII

Proportionate Composition of Staff

	Assistant Professors in Staff						Staff above Assistant Professor						Staff below Assistant Professor						
	Yr.	%	Yr.	%	Yr.	%	Yr.	%	Yr.	%	Yr.	%	Yr.	%	Yr.	%	Yr.	%	
California	'87	5.6			'07	26.4	'87	44.5			'07	26.8	'87	50			'07	46.8	Assoc. and full above.
Chicago			'00	14.7	'08	14.1			'00	36.9	'08	39.9			'00	49.4	'08	46	Assoc. and full above. Also professorial lecturers.
Columbia	'89	6.1	'00	4.3	'09	10.7	'89	16.7	'00	20.5	'09	27.7	'89	77.2	'00	75.2	'09	61.6	Adjunct profs. Probably more legitimate to take "associates."
Cornell	'89	16.5			'09	17.1	'89	35			'09	18.2	'89	48.5			'09	64.7	
Harvard	'89	15.2	'00	12.2	'04	13.7	'89	37.3	'00	23.2	'04	23.8	'89	47.5	'00	64.6	'04	62.5	A few associates.
Indiana	'89	0	'00	23.8			'89	85.2	'00	40.2			'89	14.8	'00	36			Assoc. and full above.
Iowa	'89	7	'00	9			'89	69.6	'00	53.9			'89	23.4	'00	37.1			
Johns Hopkins	'89	20.8	'00	20.7	'08	18.5	'89	56.4	'00	45	'08	46	'89	22.8	'00	34.3	'08	35.5	Called "associates." Assoc. and full above.
Kansas			'00	28.4	'09	25.2			'00	56.7	'09	42.5			'00	14.9	'09	32.3	Assoc. and full above.
Leland Stanford Jr.	'91	15.6			'09	18.2	'91	46.9			'09	35.3	'91	37.5			'09	46.5	" " " "
Minnesota	'89	11.1	'00	8.7			'89	66.7	'00	30.4			'89	22.2	'00	60.9			" " " "
Missouri	'89	22.6	'00	15			'89	67.7	'00	66.7			'89	9.7	'00	18.3			" " " "
Wisconsin	'89	11.5	'00	22	'07	15	'89	73.1	'00	34.6	'07	26.4	'89	15.4	'00	43.4	'07	58.6	" " " "
Yale	'89	6.3	'00	7.7	'09	18.4	'89	46.5	'00	36.5	'09	27.4	'89	47.2	'00	56.7	'09	54.2	

[9] See also SCIENCE, May 14, 1909, pp. 767–770.

this rank has diminished to about one half what it was twenty years ago, and the proportion of the lower ranks has correspondingly increased. The assistant professor of to-day, in other words, must win his way *out* of a larger group and *into* a much smaller group, relatively, than did the assistant professor of twenty years ago. This means that the competition is severer both for the position and for promotion out of it.

The replies to query 2*c* were unanimous that the present requirements for the position are more exacting than they were twenty years ago. These facts explain the high age of the men (36.8 average) shown in Part I.

When we compare our incomplete results with those shown in Bulletin No. 2 of the Carnegie Foundation (pp. 29–32), we find our average reported salary of $1,790 for twenty of the strongest institutions as compared to an average of $1,600 for about one hundred institutions. It is there found that the age of entrance to a grade allotted an average salary of $1,500–$2,000 is thirty years. We find from our replies 31.25. This checks remarkably well, the difference being such as we should expect to find, owing to the difference represented by the smaller and the larger group of institutions.

The returns for the age of entrance into full professorship, there stated to be 34 years, based on those *now holding* the rank, would show a considerable change, I feel sure, if we had the average of those *now being appointed* to that rank. This is obvious, since a large proportion of those making up the entrance age of 34 were appointed under the conditions prevailing 15 to 20 years ago. The conclusions drawn on page 32 of the bulletin: "A man acceptable to these institutions for a position worth $1,250 will be on the average 25 years old; a man appointed to a position worth $1,750 will be on an average 31 years old when appointed to it; one appointed to a position worth $2,500 or over will be on the average 34 years old" necessarily refer to what has been rather than to what is.

It would probably be nearer present-day facts in the average of these institutions to state that from 27 to 31 a man receives an average salary of $1,100; from 31 to 41 an average of $1,800, and from 41 on $2,500 or more. It would be interesting to get the actual facts in any institution as to this trend in change of age of promotion, by taking the average age of those promoted to full professorship in each year for the past twenty-five years; thus showing the tendency as affecting the most highly successful members of the profession.

Table VIII. has been compiled partly from the replies, partly from data already in the hands of the writer, and partly from Bulletin No. 2 of the Carnegie Foundation. Owing to its incomplete nature, we are not justified in drawing from it the general conclusions which it was hoped to obtain. It is, however, introduced on account of its value for purposes of comparison.

The replies to the queries in general are grouped alphabetically by institutions, and are, by permission, credited to their authors.

Queries 2*a*, *b* asked:

(*a*) Whether any basis of requirements for eligibility to promotion from instructorship to assistant professorship had been formulated, and (*b*) what would be considered suitable qualifications.

The replies:

(*a*) No. (*b*) It would be difficult to be precise. An instructor's term is three years. One or two such terms should indicate whether one is qualified for promotion.—President Judson.

TABLE VIII

Salary of Assistant Professor

(compiled from various sources)

	Year	Minimum	Maximum	Average	Year	Minimum	Maximum	Average
California	'89			1,800	'07			1,620
Chicago					'09	2,000	2,500	2,102
Clark					'07			1,650
Columbia[10]					'07			2,201
Cornell	'88			1,760	'07			1,715
Harvard	'89	2,000	2,500		'07 '09	2,500	3,000	2,719
Illinois					'07			1,851
Indiana					'09	1,000	1,300	1,083.33
Iowa	'89	1,200	1,800	1,400	'09	1,100	1,800	1,418
Johns Hopkins					'07			1,344
Kansas	'89			1,050[11]	'09	1,000	1,500	1,250
Leland Stanford Jr.	'91	2,000	2,500	2,250	'08	1,500	2,500	1,827
Michigan					'07			1,624
Minnesota	'89	800	1,350	1,162.5	'09	1,400	2,400	1,791
Missouri					'09	1,500	2,000	1,800
Nebraska					'07			1,500
Pennsylvania					'07			1,850
Princeton					'07			1,824
Virginia					'07			1,425
Wisconsin	'89	1,100	1,500	1,250	'09	1,500	2,500	1,733
Yale	'88	1,750	2,500	1,900	'09	1,800	2,500	2,100[12]

(*a*) No fixed requirements. (*b*) I should be unable to put them into the shape of any fixed formula.—President Lowell.

(*a*) The doctor's degree or the equivalent. (*b*) If, as is usually the custom, the assistant professor is to teach freshmen, he should be a man whose character, disposition and training make him fit for this important work. Many young doctors are notably unfit.—President Bryan.

(*a*) The university has not definitely formulated a basis of requirements for eligibility for promotion from instructors to assistant professors. (*b*) Assistant professors should be from 30 to 35 years of age; have had training equivalent to that required for the degree of doctor of philosophy; should have demonstrated their ability as teachers to impart knowledge and inspire interest in their subject; should have had a minimum of perhaps five years of teaching experience.—President MacLean.

(*a*) Nothing very definite. (*b*) Ordinarily the instructorship should serve as an apprenticeship for the candidate for a position in the required teaching force of the institution. The instructor should have such training and qualifications as to fit him for the minor work in his department, and to cause him to be seriously regarded as a prospective candidate for permanent position.—Dean Templin.

(*a*) A man who fills well a position permanently needed. (*b*) (1) Character. (2) Teaching ability with enthusiasm. (3) Scholarship. (4) Fitness for advancement as an original scholar. I should place age and experience lowest.—President Jordan.

(*a*) No. (*b*) Age 23 to 30. Scholarship, A.B. and Ph.D. degrees with what they are supposed to indicate. Teaching ability, clear view of things and power to impress and inspire. Experience, as much as possible at the age.—President Northrop.

(*a*) The general understanding is that for promotion to rank of assistant professor, a man must give definite evidence of productive scholarship as well as teaching ability. (*b*) Can not formulate answer.—President Hill.

(*a*) No. (*b*) Do not feel able to formulate answer to this question offhand.—President Van Hise.

(*a*), (*b*) We promote a man from an instructorship to an assistant professorship if, after three years of teaching, he has shown exceptional fitness for teaching and research; or if, after five years of teaching, he has shown such reasonable degree of success in instruction and administration as entitles him to promotion.—President Hadley.

Query 2*c* asked if these requirements are more exacting than they were twenty

years ago. The replies were unanimous that they are so.

Query 3*a*, *b*, asked the minimum, maximum and average salaries paid in this rank now, and twenty years ago. The replies are included in Table VIII.

The question to be raised here is, ignoring all change in cost of living, whether there has been a change in salary commensurate with the higher requirements for the position. Of the nine institutions whose data are available, three (California, Cornell, Stanford) show an actual decrease in the average rate of salary for the assistant professorship; one (Iowa) shows practically no change; one (Yale) an increase of 10 per cent.; one (Kansas) an increase of 20 per cent.; one (Harvard) about 25 per cent.; one (Wisconsin) about 40 per cent.; and one (Minnesota) 55 per cent.

The increase at Wisconsin has been uniform over the period, as can be seen from the following table:

Year	1889	1892	1901	1907	1909
Salary	$1,250	$1,383	$1,500	$1,636	$1,733

At Harvard the increase came suddenly about three years ago, due to the Teachers' Endowment Fund; and at Minnesota suddenly about two years ago, largely due to the pressure brought to bear by the alumni upon the legislature and regents, in consequence of which a considerable general increase was made in the salary roll.

In looking at Table VIII., it should be borne in mind that some of these institutions have the associate professorship, intermediate between assistant and full professorship, while some do not.

[10] New regulations 1909. $1,600 at appointment, 100 annual increment four years.

[11] An increase of 20 per cent., approximately, in twenty years.

[12] Two or three exceptional cases make an apparent range from $1,500 to $3,000.

Query 3*c* asked, from the point of view of the value of their services to the institution, what would be considered a proper ratio between the average salaries of assistant and full professors.

The replies:

With us the assistant professor's salary is from $2,000 to $2,500, and the full professor's from $3,000 to $4,500. That indicates our view.—President Judson.

A little less than double.—President Lowell.

Assistant professors should have a higher salary. Full professors should have salaries sufficient to induce the best men to follow this occupation.—President Bryan.

From the point of view of the value of their services to the institution as well as from the point of view of the demands upon them, the assistant professor's salary should be roughly two thirds or three fourths that of the full professor.—President MacLean.

One to two.—Dean Templin.

Average about half. But "full" professors do not always "grade up."—President Jordan.

Impossible to establish a fixed rate. If professors get $3,500, assistant professors ought, after trial, to get $2,500.—President Northrop.

At present the salaries of [assistant professors range from $1,500 to $2,000, average $1,800 and of] full professors here range from $2,200 to $3,000. This seems as fair to the former as to the latter class.—President Hill.

Question disregards fact that at Wisconsin we have associate professors.—President Van Hise.

It must depend wholly upon the character of the institution.—President Hadley.

Queries 4*a*, *b*, *c* were drawn up to elicit information regarding: (*a*) Recognition of the existence of a class of permanent assistant professors, (*b*) if it existed, whether the present salaries were adequate for efficient life service, and (*c*) calling for suggestions in regard to meeting the problem of a permanent class of assistant professors.

The replies:

(*a*) Not formally. Practically an assistant professor who may not expect promotion would not be continued in the faculty. (*b*) It is not considered by us expedient to have such a perma-

nent class. (*c*) I should not have such a class at all.—President Judson.

(*a*), (*b*) We do not. After a certain length of service an assistant professor has hitherto been expected to win promotion or drop out. (*c*) This is a difficult problem as yet unsolved.—President Lowell.

(*a*) Yes. (*b*) No. (*c*) Instead of making a permanent class of assistant professors I would make a special class of professors who devote themselves to the training of college boys—a task as important as that of those who devote themselves to research.—President Bryan.

(*a*) We do not at present. (*b*) If conditions tend to form a permanent class of assistant professors the present salaries will not be adequate for efficient life-service in this work. (*c*) I would give them votes in the faculty and after the first five years of satisfactory service, life tenure and make their salaries proportionate to full professors' salaries rather than to instructors' salaries.—President MacLean.

(*a*) Yes. (*b*) No.—Dean Templin.

(*a*) Those most indispensable as men or as teachers or in research may look forward. (*b*) No. Salaries should be higher and discriminations keener. (*c*) I wish I could give any. It is one of the administrative problems most difficult to handle.—President Jordan.

(*a*) No. They are permanent if good enough. If vacancy occurs above them they may or may not be promoted. It depends upon whether a better man can be obtained. (*b*) No. There should be a general lifting of the salaries of the whole grade. (*c*) None.—President Northrop.

(*a*) No. All assistant professors are on permanent appointment and may look forward to promotion. (*b*) I think not, but with chance for promotion before all, the salary seems reasonable for assistant professors in comparison [about two thirds of full professors' salary]. (*c*) I should prefer not to make a man "assistant professor" till he demonstrates his fitness and capacity to become "professor" when maturer. I would also treat all teachers of professorial rank as equal in freedom, initiative, etc., before the administration.—President Hill.

(*a*) Assistant professors for definite period of appointment, commonly three years; associate professors, indefinite. (*b*) Salaries for assistant professors are too small, but not more so than for other classes of staff. [Ratio to full professors' salary (1907), associates 73.5 per cent., assistants 59 per cent., instructors 38.5 per cent.] (*c*) Would keep rank of assistant professor for definite period, and make that of associate professor permanent appointment.—President Van Hise.

(*a*) We desire not to form a permanent class of assistant professors if we can help it. If a man is not ready to rise above $2,500 with us, we make it easy for him to go to some other institution where research qualifications are less necessary for a full professorship. It occasionally happens that a man makes himself more useful to us as assistant professor than he could anywhere else and obtains a quasi-permanent position of this kind. (*b*) No. (*c*) I think it can be practically done away with if we recognize that nearly all men who make good assistant professors will make better independent teachers in schools where original deep thought is not so much required as it ought to be in university teaching.—President Hadley.

At Columbia it is recognized that there are certain men who might well remain assistant professors so long as they were in service, no matter what their compensation or the length of their experience. Persons whom it might prove to be desirable to retain in the service of the university, either as instructors or assistant professors, might, after having served for five years, be appointed by the trustees to serve during their pleasure, and their salaries fixed regardless of their grade. By making this provision for academic officers of this type, who are rather numerous, much of the pressure which is now felt to advance men to adjunct professorships and professorships, in order to reward them for long service or to give them increased compensation, would be relieved.

Queries 4*d*, *f*, *g*, *h*, *i* and *j* had bearing on the relation of length of service to salary and promotion. 4*d* asked whether salaries were graded with respect to length of service.

The replies:

Yes. $2,000 for first four-year appointment. $2,500 on reappointment.—President Judson.

Yes. $2,500 for first five-year appointment. $3,000 on reappointment.—President Lowell.

Yes.—President Bryan.

Length of service is one element to be taken into consideration.—President MacLean.

Yes.—Dean Templin.

Theoretically not so much as in fact.—President Jordan.

Yes.—President Northrop.

Yes, but not entirely, and we reckon the service elsewhere as well as here.—President Hill.

Yes.—President Van Hise.

First three years, $1,800; next five years, $2,500. A continued appointment after eight years' service is a rare exception.—President Hadley.

4*f* inquired whether length of service should constitute any claim to promotion.

The replies:

Not by itself.—President Judson.

Yes, if the other qualifications exist.—President Lowell.

No.—President Bryan.

One claim for promotion, but only one and must be considered with several other factors.—President MacLean.

Not alone, but should be considered.—Dean Templin.

Not much.—President Jordan.

Yes, other things being equal.—President Northrop.

Not apart from essential qualifications.—President Hill.

Yes.—President Van Hise.

Not after reaching the age where maximum service can be rendered.—President Hadley.

4*g* asked the length of service of the senior assistant professor in the institution.

The replies:

Fourteen years.—President Judson.

Not over ten years.—President Lowell.

Eight years.—President Bryan.

Eight years.—President MacLean.

Ten years.—Dean Templin.

Eight years.—President Jordan.

Eighteen years.—President Northrop.

Eight years.—President Hill.

Sixteen years.—President Van Hise.

Eight years. One with nominal rank, seventeen years.—President Hadley.

4*h* inquired the percentage of assistant professors promoted each year, on the average.

The replies:

20 or 21 per cent.—President Judson.

Cornell promoted nineteen assistant professors last year.—President Schurman.

Assistant professors are promoted at the expiration of the second five-year term—with very rare exceptions.—President Lowell.

Perhaps one or two [men?].—President Bryan.

One, two or three promotions out of eight to sixteen or seventeen.—President MacLean.

10 per cent.—Dean Templin.

9 per cent., average past six years.—President Jordan.

Can't tell. It depends on needs and money.—President Northrop.

Unable to answer, as I have been president only one year.—President Hill.

12 per cent., average for past seven years.—President Van Hise.

Perhaps from 5 to 10 per cent.—President Hadley.

4*i*, *j* asked (*i*) whether promotions are as rapid or as general as the highest efficiency of the institution demands, and (*j*) if not, what are the chief causes of delay.

The replies:

(*i*) On the whole, yes. Rapid promotion is seldom desirable. (*j*) We have sometimes been delayed by lack of funds.—President Judson.

(*i*) Yes, I think so.—President Lowell.

(*i*) No. (*j*) Lack of money.—President Bryan.

(*i*) No. (*j*) Financial reasons.—President MacLean.

(*i*) Yes.—Dean Templin.

(*i*) Yes, but salaries are too low.—President Jordan.

(*i*) Yes, in most cases. (*j*) Lack of money.—President Northrop.

(*i*) Yes, I think so, as there are no barriers to the promotion of men who win the right. (*j*) Financial causes are most likely to operate against promotions here, but I do not believe that difficulty is as serious as appears in some institutions. In most deserving cases adjustments can be made.—President Hill.

(*i*), (*j*) Yes, so far as rank is concerned, but not as rapidly as desirable in the matter of money.—President Van Hise.

(*i*), (*j*) If I understand the question, I think so. Of course, if we had more money we should make more promotions instead of allowing some of our good men to go away; but I do not think increased rapidity of promotion as important a question as increased salaries for full professors. —President Hadley.

Query 4*e* asked the essential qualifications for eligibility for promotion from assistant professorship to the rank above. In considering the replies it is to be borne in mind that some of these institutions have an associate professorship and some have not.

The replies:

Assured capacity as a scholar and teacher, and as a productive investigator. Of course, personal character is fundamental.—President Judson.

I could not formulate this with definite precision.—President Lowell.

An adequate measure of excellence of some sort, primarily in scholarship, but excellence in the training of college youths is also recognized as a valid ground for promotion.—President Bryan.

Scholarship, proved by the results of a reasonable amount of research work together with some publications; teaching ability, proved by perhaps ten years of successful teaching; the test of success being applied a little more rigidly when promotion to a professorship is made, than before promotion to an assistant professorship.—President MacLean.

To be promoted, the assistant professor must have established himself as a permanently desirable member of the university faculty. His scholarship must be beyond question, as must also be his ability either as a teacher or an investigator.—Dean Templin.

(1) Character. (2) Ability as teacher. (3) Ability to form independent judgments. (4) Enthusiasm in work.—President Jordan.

Thorough knowledge of the subject, and executive ability to manage the department, and enthusiasm for the work that will inspire assistants and pupils.—President Northrop.

Greater maturity and more complete demonstration of ability in research, teaching, and general usefulness to the university.—President Hill.

Before promoting from assistant to associate professor, must become convinced that instructional power and investigational capacity sufficiently high, so that institution desires services of man for life.—President Van Hise.

The three qualifications for full professorship, in the order of average importance are, original scholarship, organizing ability and teaching power. Teaching power is placed third, not because of any under-estimate of its importance, but because men who are good teachers at thirty, but have not original scholarship or organizing ability, are apt to be (I do not say are always) less good teachers at fifty.—President Hadley.

To determine the academic and administrative status of the assistant professors, questions 5*a*, *b*, *c* and *d* were drawn up. They inquired (*a*) the participation of this rank in the legislating bodies, faculty, council, senate, etc.; (*b*) the voice in departmental matters; (*c*) whether on the same footing as full professors in respect to appointment to administrative and academic committees, which formulate, control or direct educational policies; and (*d*) in respect to appointment as executive heads of departments.

The replies:

(*a*) The senate consists of full professors. Council, of administrative officers only. Assistant professors are members of all faculties. (*b*) Yes. (*c*) Yes. (*d*) No.—President Judson.

(*a*) Yes. (*b*) Yes. (*c*) Yes. (*d*) Nearly so. —President Lowell.

(*a*) They are made so by law. (*b*) In most cases, yes. (*c*) Yes. (*d*) We have no such cases. —President Bryan.

(*a*) Not members of university legislating bodies. (*b*) Presumably they have a voice in departmental matters, though it can not be said that there is uniformity of practise in the different departments. (*c*) May be appointed, but such appointments are rare. (*d*) Occasionally made acting heads of departments. This is only on occasions when there is no one of rank of professor in the department.—President MacLean.

(*a*) Are members of the faculties of their schools, but not of the university council. (*b*) Yes. (*c*) Theoretically, yes. (*d*) No.—Dean Templin.

(*a*) Are members of faculty. New appointees are not admitted to council until the end of three years. (*b*) Yes, by regulations. (*c*) All mem-

bers of council eligible to all committees. The advisory board, however, is elected by the council from the full professors only. (*d*) Have been sometimes acting heads, where there was no full professor.—Stanford.

(*a*) Faculty, yes. Council, no. (*b*) Subject to the head of the department. (*c*) Yes. (*d*) If there is a head professor, he is head. If there is none, an assistant professor in the department may act as head.—President Northrop.

(*a*) Yes. (*b*) They are supposed to have, and our policy is to give them, equal voice with full professors. (*c*) Yes. (*d*) They have not been in the past, but I have positively committed my administration to an affirmative answer to this question for the future. I have had no new permanent heads of departments appointed, and shall not hesitate to appoint assistant professors.—President Hill.

(*a*) Yes. (*b*) Yes. (*c*) Yes. (*d*) Yes as to law, but not as a matter of practise.—President Van Hise.

(*a*) They are members of the faculty and have votes in all administrative matters; but they are not as a rule members of the higher bodies that deal with legislation in the narrower sense. (*b*) Yes. (*c*) Practically so, except as the greater experience of full professors creates a greater demand for their services on committees. (*d*) No. It is only in exceptional cases that an assistant professor becomes an executive head of a department.—President Hadley.

Question 5*e* asked whether it was advisable for the younger men of an institution to take an active part in forming and executing its policies, and if so, why.

The replies:

Yes. For their own development, and to prevent the undue conservatism of age.—President Judson.

Yes. Because he is more apt to be progressive.—President Lowell.

Yes, assuming that the younger men are on the average equal in ability to the older, they have the advantages of their youth in terms of spontaneity and energy, and these should not be lost to the university.—President Bryan.

I think it advisable. With the balance given by the older men of the faculty the university has the advantage of the strength and activity of the younger men, without the danger of their forcing wrong policies on the institution through lack of judgment. Their recognition as a part of the administrative machinery, which does not exist if the younger men are not taken into the administrative counsels.—President MacLean.

Yes, to promote progress.—Dean Templin.

Yes, in order to realize their difficulties. But they should not be too zealous before studying problems.—President Jordan.

Yes. Because the institution may profit by the best thought of all—and the younger men sometimes know more than the older.—President Northrop.

I do. Because they can often render valuable services, and because they thus become more serviceable, more loyal to the institution, and find greater satisfaction in their work.—President Hill.

Yes. Advantageous to have them consider themselves as part of the institution in the full sense.—President Van Hise.

Yes. I regard it as self-evident.—President Hadley.

Query 5*f* asked whether it was desirable to have departments conducted on a democratic or autocratic basis.

The replies:

A qualified democracy is the better.—President Judson.

Democratic.—President Lowell.

Autocracy means, as a rule, more immediate efficiency. Democracy of the right sort means lasting health in the organization, with all the good consequences which flow therefrom.—President Bryan.

It is desirable that departments be conducted on a democratic basis.—President MacLean.

Neither. Republican rather.—Dean Templin.

Democratic in so far as experience and circumstances permit.—President Jordan.

Democratic with a *head*.—President Northrop.

Democratic.—President Hill.

Democratic.—President Van Hise.

It depends wholly upon the men you have on the staff. If the president is wise and the rest of the teaching force foolish, it is desirable that it should be autocratic. If the president is foolish and the rest of the teaching force are wise, it is desirable that it should be democratic.—President Hadley.

To the request for suggestions concerning the problem of the assistant professorship, looking toward higher individual or institutional efficiency, there was much more reticence on the part of the presi-

dents than on the part of the assistant professors. Two replies only were received. Fortunately, they sum up the conclusions most adequately:

> The principle ought to be established that "there is always room at the top." Under an autocratic system or even where permanent appointments are made of "heads of departments," there is never room at the top. A more democratic organization of department faculties seems to me to be one of the most important and pressing reforms demanded in educational institutions. —President Hill.
>
> Better pay: greater insistence on superior life —which involves zeal, character, interest in students, interest in knowledge and ability to distinguish scholarship from pedantry.—President Jordan.

The writer's task is completed. For the opportunity offered him to prepare this paper, and to all those who burdened themselves with so thoroughly answering his many questions, he wishes to express his grateful thanks. He has made no attempt to trace the historical development of the assistant professorship in the American university system, nor to disentangle the combinations of regular and acting, adjuncts, assistants, associates and juniors where these exist,[13] nor to show the possibilities of university teaching as a career. He has merely tried to present a faithful cross-section of the existing conditions of the assistant professorship in the institutions represented in this association.

Both sides have been heard; their conclusions are in striking accord. The initiative for improved administrative status and adequate salaries lies in the hands of the one; that for increased zeal, worth and efficiency in the hands of the other. The outlook is full of opportunity and promise.

GUIDO H. MARX

[13] One institution has twenty regular titles in its list of staff.

APPENDIX A
QUERIES FOR ASSISTANT PROFESSORS

Suggestions and comments on points not covered below will be gratefully received.

1. Age?
2. Degrees?
3. Years spent in collegiate and graduate (or professional) study?
4. To what extent did you hold fellowships or receive similar assistance?
5. To what extent did you go into debt for your training?
6. How long did it take to pay this debt?
7. Length of teaching service below rank of assistant professor?
8. Length of teaching service in rank of assistant professor?
9. Married or single?
10. Number of children?
11. Present salary?
12. Average salary during entire teaching service?
13. Total savings from salary (exclusive of insurance)?
14. To what extent have you supplemented your salary by income from other sources?
15. Is your income sufficient to make both ends meet or are you running behind?
16. If willing, will you state your present net deficit or indebtedness?
17. How much insurance do you carry?
18. What are your opinions concerning the status of the assistant professorship (*a*) in sharing in the determination of general policies of your institution; (*b*) in departmental policy, curriculum and assignment of courses; (*c*) in conduct (*i. e.*, direction) of individual classes?
19. What are the conditions of nature and amount of work, etc., and do these reasonably favor carrying on advanced work and intellectual growth?
20. What are the conditions governing tenure of the assistant professorship and are they the best for reasonable independence of thought and action?
21. Have you any suggestions to make, concerning the problem of the assistant professorship, looking toward higher individual or institutional efficiency?

APPENDIX B
QUERIES FOR PRESIDENTS

Suggestions and comments on points not covered below will be gratefully received.

1. Kindly fill in this table:

	'89–'90	'99–'00	'09–'10
Number of full professors			
Number of associate "			
Number of assistant "			
Number of instructors			
Number of assistants			
Number of students			

2. *a* Have you formulated any basis of requirements for eligibility to promotion from instructorship to assistant professorship?
   b What would you consider suitable qualifications of age, training, scholarship, teaching ability, experience, etc.?
   c Do you consider the present requirements for the position of assistant professor to be more or less exacting than they were twenty years ago?
3. *a* What are the minimum, maximum and average salaries paid assistant professors of your staff this year?
   b What were these salaries in 1889–1890?
   c From the point of view of the value of their services to the institution, what would you consider a proper ratio between the average salaries of assistant professors and of full professors?
4. *a* Do you recognize two general classes of assistant professors, temporary and permanent; that is, those who may reasonably look forward to promotion and those who, for one reason or another, may not?
   b If conditions tend to form a permanent class of assistant professors, are present ruling salaries adequate for efficient life-service in this rank?
   c What suggestions would you make in regard to meeting the problem of a permanent class of assistant professors?
   d Do you grade assistant professors' salaries at all with respect to length of service?
   e What do you consider essential qualifications for eligibility to promotion from assistant professorship to the rank above?
   f From the point of view of the administration, should length of service constitute any claim for promotion?
   g How long has your senior assistant professor served in this rank?
   h On the average, what percentage of assistant professors are promoted by you each year?
   i Are promotions as rapid or as general as the highest efficiency of the institution demands?
   j If not, what do you consider the chief causes of delay?
5. *a* Are your assistant professors members of the legislating bodies, faculty, council, senate, etc.?
   b Have they a voice in departmental matters?
   c Are they on the same footing as full professors in respect to appointment to administrative and academic committees which formulate, control or direct educational policies?
   d In respect to appointment as executive heads of departments?
   e Do you consider it to be advisable for the younger men of an institution to take an active part in forming and executing its policies? Why?
   f As a matter of the highest efficiency of the institution, do you consider it desirable to have departments conducted on a democratic or autocratic basis?
6. Have you any suggestions to make concerning the problem of the assistant professorship, looking toward higher individual or institutional efficiency?
7. Are you willing to have your name attached to quotations from these answers?

SCIENTIFIC NOTES AND NEWS

MR. ALEXANDER AGASSIZ died on March 28, on the steamship *Adriatic*.

SIR ERNEST SHACKLETON gave an address on his Antarctic explorations before the National Geographic Society on March 26, and was presented with the gold medal of the society by President Taft. On March 28 he addressed the American Geographical Society in New York City and received its gold medal.

THE date for the delivery of the Romanes lecture at Oxford University by Mr. Roosevelt has been fixed for Wednesday, May 18.

AT the annual meeting of the Institution of Mining and Metallurgy in London, on March 17, the following awards were presented: the gold medal of the institution to Professor William Gowland, the "Consolidated Gold Fields of South Africa," gold medal to Mr. W. A. Caldecott and the premium to Mr. C. O. Bannister and Mr. W. N. Stanley.

In a convocation at Oxford on March 15 a decree was passed unanimously, on the motion of Professor Elliott, conferring the title of professor emeritus on Edward Burnett Tylor, M.A., Hon. D.C.L., honorary fellow of Balliol College, who on December 31 last resigned the office of professor and reader in anthropology after a tenure of twenty-six years.

Dr. Alexander C. Abbott, of the University of Pennsylvania, has been selected as a delegate to the International Congress of Hygiene and Medicine, which meets in Buenos Ayres, Argentine Republic, next month.

Dr. E. E. Southard, of the Harvard Medical School, has been appointed by President W. C. Gorgas a member of the council on medical education of the American Medical Association, to fill the unexpired term of Dr. W. T. Councilman.

At the annual meeting of the Ray Society held in London on March 10, Lord Avebury, F.R.S., was reelected president; Dr. S. F. Harmer, F.R.S., was elected a vice-president; Mr. F. DuCane Godman, F.R.S., was reelected treasurer, and Mr. John Hopkinson was elected secretary.

Dr. Sambon has been sent to Italy by the Pellagra Investigation Committee. Captain Siler, U. S. A., has been officially welcomed as a member of the field commission, and two assistants, Messrs. Baldini and Amoruso, have been appointed.

Dr. Henry S. Pratt, professor of zoology at Haverford College, will spend next year in foreign zoological laboratories.

It is reported that Captain Amundsen has modified his plans to the extent of postponing his departure from Norway till June of this year, and his final passage of Bering Strait till August, 1911, devoting most of the intervening period to oceanographical research in the South Atlantic during the outward voyage. He also proposes to carry out extensive investigations of the upper atmosphere during the drift across the Polar basin.

Dr. Maurice Vejux Tyrode, faculty instructor in pharmacology in the Harvard Medical School, has presented his resignation to take effect on September 1, 1910.

Professor Leonard P. Kinnicutt, of the department of chemistry of the Worcester Polytechnic Institute, on February 18, gave a talk to the students of Union College and the Engineering and Chemical Societies of Schenectady on the "Bacterial Methods of Sewage Disposal."

Professor G. H. Parker, of Harvard University, lectured on March 4, before the Buffalo Society of Natural History on "The Structure and Origin of Coral Islands."

Mr. Cyrus C. Adams, of the American Geographical Society, gave a lecture on "Arctic Exploration," before the geological department of Colgate University, on March 21.

There was on March 25 and 26 at the State University of Iowa a joint meeting of the Western Philosophical Association, the North Central Section of the American Psychological Association and the Teachers of Psychology in Iowa. The address of the president of the Western Philosophical Association, Professor Carl E. Seashore, was on the "Rôle of Play in Religion."

At the annual general meeting of the Society of Dyers and Colorists held at Manchester, on March 18, the retiring president, Professor R. Meldola, F.R.S., delivered an address on "Tinctorial Chemistry—Ancient and Modern." Sir Frederick Cawley has been elected to the presidency.

At the annual meeting of the Chemical Society, London, on March 18, the president, Professor Harold B. Dickson, F.R.S., made an address on "The Union of Hydrogen and Oxygen in Flame."

The fourth annual meeting of the British Science Guild was held at the Mansion House, London, on March 18, under the presidency of the Lord Mayor. Addresses were delivered by the Right Hon. R. B. Haldane, F.R.S., and others.

The seventieth birthday of Ernst Abbe, who died five years ago, has been celebrated at Jena, where it is planned to erect a monument

in honor of his contributions to optical science and his foundation at the university.

THE *Journal* of the American Medical Association states that the famous ophthalmologist, Professor Jaeger von Jaxtthal, who died in 1884, has been honored by the erection of a life-sized statue in the hall of the University of Vienna. Professor Fuchs delivered the commemorative address. Jaeger was the son of a famous ophthalmologist: was the grandson, on his mother's side, of the famous ophthalmologist Beer, and was married to the daughter of Arlt, also an eminent ophthalmologist.

DR. WHARTON SINCLAIR, an eminent neurologist, a trustee of the University of Pennsylvania, died at Philadelphia on March 15.

HENRY AUGUSTUS TORREY, assistant professor of chemistry at Harvard University and known for his work in organic chemistry, died at Cambridge, on March 26, at the age of thirty-eight years.

DR. H. LANDOLT, professor of chemistry at the universities of Berlin and Bonn, eminent for his contributions to physical chemistry, died on March 14 at the age of seventy-eight years.

PROFESSOR K. J. ANGSTRÖM, professor of physics in the University of Upsala, died on March 4 at the age of fifty-three years.

DR. C. PHILIPPI, professor of geology at Jena, has died in Egypt.

M. YOUX, professor of mathematics at Paris, has died at the age of eighty-one years.

THERE will be a civil service examination in New York State on April 23, to fill various positions, including that of medical superintendent of Letchworth Village, the new state institution for the feeble-minded and epileptic. The salary of this position is $4,500 with maintenance for the superintendent and his family.

KING ALBERT of Belgium will give $200,000 for investigations into the nature and prevention of sleeping sickness. He will also give $100,000 for hospitals for natives of the Congo.

CARRIMBHOY EBRAHIM has given to the Bombay government a sum of $150,000 for research and the provision of scholarships to science students of the Mussulman faith.

THE seventh International Congress of Criminal Anthropology, which was to have been held at Cologne in August next, has been postponed till October, 1911.

THE third International Congress of School Hygiene will be held at Paris from August 2 to 7, under the honorary presidency of the minister of public instruction. The subjects selected for discussion at the general meetings are: "Physical examinations in schools"; "Sexual education and school physicians." The congress will further meet in eleven sections for the discussion of various topics in school hygiene. Especial reductions are given by the railways and steamships, and visits to schools and other excursions have been organized. The circular of information further says: "Nothing will be spared to make the stay in Paris easy to the congressists." The secretary of the congress is Dr. Dufestel, 10 Boulevard Magenta, Paris.

AT the regular weekly meetings of the University of Colorado Scientific Society the following scientific addresses have been given during the months of December, January, February and March: "Liquid Air and Low Temperature Phenomena," Professor Walter Runge and Mr. Harry A. Curtis; "Scientific Stories," Professor S. Epsteen; "Some Recent University Expeditions with special reference to Northwestern Colorado," Professor Junius Henderson; "The Electrolytic Determination of Metals, using Rotating Anode," Mr. Harry A. Curtis; "Relation between Climate and Crops in Colorado with special reference to Unsolved Problems," Mr. Wilfred W. Robbins; "The British Association in South Africa," Professor Henry Carhart; "Tree Planting for Colorado," Mr. D. M. Andrews; "Mysticism and Modern Psychology," Professor V. A. C. Henmon; "Real Color Photography Direct from Nature," Mr. Stanley McGinnis.

THE deans of the colleges of liberal arts of the state universities of the middle west were

in session at the University of Illinois on March 23 and 24. Those in attendance and the papers that they read at this conference were: Dean Davis, of Nebraska, "Incentives to Scholarships"; Dean Jones, of Missouri, "Systems of Grading"; Dean Hoffman, of Indiana, "What can be done for the Freshmen"; Dean Townsend, of Illinois, "Faculty Advisers"; Dean Reed, of Michigan, "What should be done with Large Classes"; Dean Downey, of Minnesota, "Group Requirements for the A.B. Degree"; Dean Greene, of Illinois, "The Future of the A.B. Degree"; Dean Templin, of Kansas, "The College and the Professional Schools"; Dean Birge, of Wisconsin, "The Building of a Faculty." Assistant Deans Rawles, of Indiana and Meyer, of Illinois, were also in attendance.

UNIVERSITY AND EDUCATIONAL NEWS

Haverford College has completed the collection of a fund for pensions amounting to about $150,000.

Sir Francis Galton has made a further donation of £500 for the maintenance of the Francis Galton Laboratory for the Study of National Eugenics in the University of London during the year 1911–12.

Vivian A. C. Henmon, A.B. (Bethany), Ph.D. (Columbia), now professor in the University of Colorado and dean, has been elected associate professor of educational psychology in the University of Wisconsin.

R. M. Ogden, A.B. (Cornell), Ph.D. (Würzburg), has been promoted to a professorship of philosophy and psychology in the University of Tennessee.

Dr. A. G. G. Richardson has been elected professor of veterinary medicine of the Georgia State College of Agriculture. Dr. Richardson was in the United States Bureau of Animal Industry for a number of years.

Dr. A. O. Shaklee, assistant in physiology and pharmacology of the Rockefeller Institute, has accepted the position of associate professor of pharmacology in the Philippine Medical School, Manila. Mr. Elbert Clark, associate in anatomy in the University of Chicago and Rush Medical College, has been appointed assistant professor of anatomy at Manila.

Professor William Moore, of Cornell University, has received an appointment to a chair in the faculty of the British Agricultural College in the Transvaal.

Sir Alfred Keogh, K.C.B., who has been elected rector of the Imperial College of Science and Technology, London, retired last year from the post of director-general of the Army Medical Service.

DISCUSSION AND CORRESPONDENCE

FRACASTORIUS, ATHANASIUS KIRCHER AND THE GERM THEORY OF DISEASE

In Science for February 18, Dr. William A. Riley gives a clear and interesting account of the relation of Athanasius Kircher to the germ theory of disease. In connection with this paper it may be of moment to note that, as Osler has pointed out,[1] the true author of the germ theory is neither Kircher nor Hieronymus Mercurialis, but Fracastorius, a Veronese physician of the fifteenth century, whose chief title to fame has been hitherto that "most popular" of medical poems, if least savory in theme, "Syphilis, sive morbus gallicus" (1530). Geronimo Fracastorio, born in 1484, studied medicine at Padua, led a tranquil, easy life as physician and poet in the countryside near the Lago di Garda, and died in 1553. His work "De contagione et contagiosis morbis et curatione," published at Venice in 1546, contains the first scientific statement of the true nature of contagion, of infection, of disease germs and the modes of transmission of infectious diseases. The latter he divides into (1) diseases infecting by immediate contact (true contagions), (2) diseases infecting through intermediate agents like fomites, (3) diseases infecting at a distance or through the air, of which class he instances phthisis, the pestilential fevers, a certain kind of ophthalmia (conjunctivitis),

[1] *Proceedings of the Charaka Club*, New York, 1906, II., 8–11.

etc. In all this Fracastorius shows himself to be a highly original thinker, far in advance of the pathological knowledge of his time, which was mainly reducible to the old Hippocratic doctrine of disease as a corruption of the humors of the body. But it is in his remarkable account of the true nature of disease germs, or *seminaria contagionum*, as he calls them, that we find him towering above his contemporaries. He seems, by some remarkable power of divination or clairvoyance, to have seen morbid processes in terms of bacteriology more than a hundred years before Kircher, Leeuwenhoek and the other men who worked with magnifying glass or microscope. These germs he describes as particles too small to be apprehended by our senses (*particulæ illæ insensibiles*), but which, in appropriate media, are capable of reproduction and thus of infecting the surrounding tissues (*prima enim seminaria, quæ adhæserunt e vicinis humoribus ad quos habent analogiam consimilia sibi alia generant et propagant, et hæc alia donec tota humorum massa et moles afficiuntur*). These pathogenic units Fracastorius clearly surmises to be of the nature of colloidal systems, for if they were not viscous or glutinous by nature, he holds, they could not be transmitted by fomites (*cujus signum est, quod quæcunque per fomitem afficiunt omnia lenta glutinosaque conspiciuntur*); while germs transmitting disease at a distance must be able to live in the air a certain length of time (*non solum in fomite sed in aere per certum tempus servari*), and this condition is only possible when the germs are gelatinous or colloidal systems; for only hard, inert, discrete particles could endure longer (*sed certe, quæ lenta sunt et glutinosa, quamquam parvissima sint, possunt quidem si non omnino tantum quantum dura, vivere, at paulo minus possunt*). These colloidal particles have the power of resisting forces of small magnitude, but can not resist such agencies as extremes of heat or cold, which reduce them to phases of dissipated energy (*non solum dura, sed et lenta sese defendunt ab alterationibus multis, si mediocres sint, magnas autem non ferunt: propter quod et ab igne absumuntur seminaria omnium contagionum, et ab aqua etiam frigidissima franguntur*). Finally Fracastorius conceives that the germs become pathogenic through the action of animal heat (*et ipsa actu fiunt a calore animalis*), and that in order to produce disease it is not necessary for them to undergo dissolution, but only metabolic change (*quantum quidem sufficit ad putrefactionem faciendam, non necesse esse corrumpi particulas ipsas, sed alterari solum . . . nihil tamen prohibet et corrumpi etiam, sed non necesse est, quatenus attinet ad faciendam putrefactionem*). Thus Fracastorius seems to have had a clear notion (or prevision) of the causation of disease by microorganisms, and he appears to have seen these organisms as made up of those gelatinous or "dispersed" systems which modern physical chemists call colloidal states of substance. The agreement of his imaginative hypothesis with the physicochemical view-point is little short of wonderful, when we consider that he had no microscope nor other instrument of precision save his own mind.

In referring to the organisms seen by Kircher, Dr. Riley asserts that he must have seen "the larger species of bacteria" long before Leeuwenhoek's discovery. But neither Kircher nor Leeuwenhoek could have seen bacteria of any kind with the lenses at their command, although the latter undoubtedly saw various animalculæ, diatoms, blood corpuscles and the finer anatomy of the tissues. According to Müller and Prausnitz,[2] Kircher saw in the blood of plague patients "a countless brood of worms not perceptible to the naked eye," and he was not staggered by the fact that these "worms" could also be found in healthy blood. The explanation is simple. His glass or microscope was only 32-power at best, and the worms he thought he saw were (as in Malpighi's case) simply rouleaux of red blood corpuscles.

To sum up, over one hundred years before Kircher, Fracastorius gave the first definite statement of the true nature of infection by disease germs; Kircher then boldly restated

[2] "Handbuch der Geschichte der Medizin," Jena, 1905, II., 805.

the hypothesis in the light of what he saw through the microscope, but the germ theory had to wait for laboratory verification at the hands of Pasteur. In connection with the theory of the transmission of disease by insects it is of interest to note that Sir Henry A. Blake, governor of Ceylon, has pointed out[3] that the mosquito theory of the origin of malaria is as ancient as the Susruta, a Sanskrit medical classic at least 1,400 years old. Quite an anthology might be compiled of references from secular literature in which swamps, mosquitoes and malaria were vaguely associated as if in causal connection before King enunciated the theory in 1882. But no one ever thought of mosquitoes in relation to yellow fever before the time of Finlay and Walter Reed.

Fielding H. Garrison
Army Medical Museum

The Lower Tertiaries of Louisiana

To the Editor of Science: In preparing manuscript for publication on the lower Tertiaries of Louisiana it has seemed desirable to have a formational name for that portion of the Eocene usually styled in our former publications "Lower Claiborne." In accordance with the wishes of the committee on nomenclature the geographic name *St. Maurice* is here proposed for these well-known Mississippi embayment marine beds.

G. D. Harris

The Length of Service Pensions of the Carnegie Foundation

The articles by Professors Cattell and Jastrow following that of Professor Lovejoy and the *Nation* editorial, have put in such strong light the disadvantages and the injustice of the recent ruling by the Carnegie Retiring Board, that it might seem little remains to be said. There can be little doubt that these articles express the sentiment of a great majority among those who have been looking forward to a service retiring allowance upon the Carnegie Foundation. Some professors who have considered the system a great aid in securing stronger American universities, have now lost all interest in it. If a professor who entered early upon teaching must continue for forty years as a professor in order to acquire any benefits from the foundation, not much inducement is offered him.

There are, as it seems to me, two considerations not specially emphasized in the articles cited, which might well be taken up. In his report recently published, the president of the foundation lays stress upon the fact that the professors thus far retired upon the foundation because of age, all laid down their work with regret, and in some cases felt hurt that they had been induced to do so. No one familiar with university men will for a moment doubt that these statements represent the facts as regards an even larger body of the older professors. Among the middle-aged and young men of universities, and it might be added the student body, the opinion is probably as general that professors generally remain at their posts after their best work of teaching has passed. This opinion of the younger men does not spring altogether from a selfish desire to fill the positions of their seniors, since their conclusion expresses a law of human nature which is exemplified in every walk of life, but perhaps most strikingly upon the concert stage. When nowadays a young man states openly that he will retire from his post voluntarily before his powers have been impaired by age, he is perhaps cynically requested to set the statement down in writing; for, once admitted into the group of the older men, it is notorious that he acquires their point of view as naturally as liberals become transformed into conservatives after their admission to the British House of Lords.

The question of the relative teaching efficiency of professors at the different ages between forty and seventy-five years, is one to be decided by results, and it would be of special interest if the statistics recently gathered by the Carnegie Foundation from the so-called accepted institutions were compared and published. If the average age of the

[3] *Jour. Ceylon Branch Brit. Med. Assoc.*, Colombo, 1905, II., 9.

teachers in each grade of university work were made public for each of the institutions in question, the reader might then draw his own conclusions based upon the relative standings of the institutions.

Aside from personal observation, there are two reasons which make it unlikely that the best work of a teacher should extend beyond a moderate term of years. In the first place, the world moves forward so rapidly that in a period of thirty-five or forty years, methods, view-points and subject-matter of the sciences are all more or less transformed. Few of our universities provide a sabbatical year in which the opportunity is offered the professor to make himself over, even if he be constructed of sufficiently plastic materials. In the second place, few men can go year after year over the same tasks without reaching a condition which in the athlete would be designated "stale." The enthusiasm of earlier years is bound to become more or less dulled, and enthusiasm and interest are vital elements to the teacher.

There is another important function of the teacher which should be carefully brought into consideration, for an insidious encroachment has been made upon it during the past decade. I refer to research, which, it will generally be admitted, should in every possible way be encouraged in the university professor. There is no really great university that has not done its part in widening the horizon of the known through the investigations by its professors. It might be safely predicted that a university which relinquished altogether this function would speedily degenerate to an inferior rank. The spirit of inquiry and of testing conclusions is, in fact, that which differentiates higher instruction from that of lower grade. It may not be generally recognized, but it seems to be true that in respect to research the American universities are to-day in a somewhat critical position as a result of the great fortunes built up through consolidation of business interests. American research is fast becoming institutional. It will probably have to be admitted that the immediate results have been so much the more increased, even though the universities have suffered by it. The enlargement of government and state scientific bureaus, the private foundation of great laboratories in the interest of medical science, and the laboratories of practical science established in connection with the great industrial concerns, have withdrawn from the universities many of the men who have made reputations by their researches. To some of those that remain the Carnegie Institution of Washington has offered some advantages, but the avowed policy of that institution is now to centralize its work more and more in the city of Washington and in its own special laboratories.

The problem thus thrust upon the universities is one that they can not afford to ignore, since it is not always easy to convince boards of regents or trustees that a professor is filling his chair with credit when a considerable portion of his time is devoted to purely research work. The service pension of the Carnegie Foundation, while not offering a full solution of this problem, had yet made the outlook more promising. If it be true that the average professor between the ages of fifty-five and sixty-five is on the whole less efficient as a teacher than the man ten years his junior, I believe that as regards research the reverse would more nearly represent the facts. Most men who have gone far in investigation have begun with smaller problems the original study of which has suggested kindred questions, so that as they have advanced the field of their studies has constantly widened until far more general and fundamental questions have been forced upon the attention and been made the subjects of inquiry. Thus the ripe period from fifty to sixty-five years of age is with little doubt the one which under favorable conditions offers the greatest opportunities for research. A paragraph in President Pritchett's letter of April 24, 1908, shows his appreciation of the opportunities the universities would secure if professors retired upon service pensions could continue their work in research upon the grounds of the university:

> I can imagine no better thing for an institution of learning than to have about it a group of men who are engaged in active research and who are not burdened with the load of teaching which

falls to most American teachers. In this way the retiring allowance will contribute directly to research.

The abuses which, it is intimated, have led to the withdrawal of the service pension, seem to have been on the whole far less serious than has been assumed. The forcing of professors of long service to resign their positions has generally carried with it such danger to the president's own tenure of office that it has rarely been undertaken. There has been additional difficulty in that an aged professor whose efficiency had been impaired would be left without adequate financial support though fully deserving of rewards upon the basis of his earlier work. With the service pension provision withdrawn it will now be incumbent upon university presidents to retain upon their staffs all professors not physically disabled up to the age of sixty-five, no matter what may be their efficiency as teachers. It can hardly be doubted that the effect will be to lower the efficiency of teaching in the universities.

Wm. Herbert Hobbs
University of Michigan,
March 15, 1910

SCIENTIFIC BOOKS

The Oxidases and other Oxygen Catalysts concerned in Biological Oxidations. By J. H. Kastle. Hygienic Laboratory Bulletin No. 59, December, 1909.

The bulletins issued by the Hygienic Laboratory at Washington constitute a most interesting and valuable series of contributions which reflect the greatest credit upon the organization and spirit of this important department of the Public Health and Marine Hospital Service. For the most part these publications consist of experimental researches dealing with topics of timely interest to physicians and biologists in general, while some of them are of the nature of résumés of the literature and the condition of our knowledge in regard to special problems. The bulletin to which attention is called here belongs to this latter class. It contains an elaborate and thorough review of the history and present status of the difficult and complex subject of oxidations particularly as they occur in living things. Since this review is written by one who himself has been a distinguished contributor to the experimental investigation of the subject it possesses the additional value of being an authoritative presentation which other biologists may use with a feeling of confidence in its accuracy. Professor Kastle modestly disclaims any pretention to completeness as regards the literature consulted in the preparation of the bulletin, but it will be noted that four hundred and sixty-seven references are given in the appended bibliography, and those who read the contribution will be impressed with the fact that the author writes out of an unusual fullness of knowledge of the subject in its chemical as well as its biological bearings. After the discovery of oxygen by Lavoisier the history of the attempts made to disclose the nature of the processes involved in the physiological oxidations of plants and animals may be divided, according to Kastle, into three periods. The first of these deals with the bluing of guaiacum, especially by extracts of plant tissues. The names that are important in this connection are Planche, Taddei and particularly Schoenbein. The last-named observer studied the subject from many sides and arrived at a clear understanding of the fact that plants and animals contain special substances, destroyed at temperatures below that of boiling water, which have the property of combining with atmospheric oxygen and activating it so that it is capable of effecting the wonderful oxidations characteristic of living things. Schoenbein himself believed that these substances render the oxygen active by ozonizing it, but this view has not been confirmed by subsequent work. The second period is connected with the work of Traube, who was responsible for emphasizing the importance of hydrogen peroxide in all oxidations, including those of living things. His peroxide theory as developed later by Bach, Engler and others does not assume that hydrogen peroxide itself is formed in the processes of physiological oxidations, but that the organic substances which combine with the oxygen, designated

by Traube as oxidizing ferments, form compounds of the nature of peroxides which promote and accelerate the oxidation of other substances. This view may be represented in its simplest form by the two following equations in which A constitutes the oxidizing ferment and B the substance whose oxidation is effected through the agency of this ferment:

$$A + O_2 = AO_2$$
$$AO_2 + B = AO + BO$$

The third period considered by the author extends to the present time and begins with the work of Yoshida, Bertrand and others upon specific oxidases, particularly upon laccase and tyrosinase. The very interesting literature upon these and related oxidases is reviewed at length, and the author suggests the following classification of the oxidases as being in accord with our present knowledge:

1. Laccase; ferments oxidizing guaiacum, guaiacol, hydroquinone, phenolphthalin, tannin, etc., directly by means of atmospheric or dissolved oxygen, and without the intervention of hydrogen peroxide.

2. Tyrosinase; ferments acting on tyrosin and related substances, and responsible possibly for the production of melanin and other pigments in plants and animals.

3. Aldehydases; ferments oxidizing aromatic aldehydes and related compounds.

4. Indophenol oxidase; ferments oxidizing a mixture of α-naphthol and para-phenylene diamine to indophenol.

5. The purin oxidases.

6. The glycolytic ferments, causing the disappearance of sugar from animal tissues.

Closely related to these oxidases are the following catalytic agents which act in conjunction with hydrogen peroxide or related organic peroxides:

1. Peroxidases; ferments which exert an oxidizing reaction only in the presence of a peroxide, such as hydrogen peroxide.

2. Catalases; ferments which actively decompose hydrogen peroxide.

3. Oxygen carriers (not true ferments); this class includes substances such as hemoglobin and hemocyanin which are capable of activating the oxygen of hydrogen peroxide, even after their solutions have been heated to 100° C.

This classification brings up the perplexing question of the distinction made between the oxidases and peroxidases. According to the well-known views of Bach and Chodat all oxygen-activating ferments are really peroxidases. So-called oxidases, such as laccase and tyrosinase, consist of certain substances (oxygenases) capable of forming with oxygen unstable compounds of the nature of peroxides. The oxygen in these peroxides is rendered active by the ferment bodies designated as peroxidases. Laccase differs from tyrosinase in the specific nature of the constituent peroxidase. Kastle evidently does not hold to this or similar views, but recognizes the existence of at least two classes of oxidizing ferments, the oxidases and the peroxidases, as defined in the classification given above. As far as the peroxidases are concerned, he conceives that they are substances which are capable of producing peroxides either by double decomposition with hydrogen peroxide, or by forming an unstable addition product with hydrogen peroxide. These two possible reactions and the resulting activation of the oxygen are indicated schematically in the following equations in which P represents a peroxidase:

(1)
$$P + H_2O_2 = PO_2 + H_2O$$
$$PO_2 + B = BO + PO, \quad \text{or}$$
$$PO_2 + 2B = P + 2BO$$

(2)
$$P + H_2O_2 = H_2PO_2$$
$$H_2PO_2 + B = P + BO + H_2O$$

Kastle emphasizes the fact that the peroxidase reaction, as also the catalase reaction, constitutes one of the most universal and persistent properties of living tissues. When these reactions fail there can be no question that the tissue or organism concerned is dead.

In other sections of the review the author treats of the oxygen catalysts of blood in health and disease; of the very interesting discoveries in regard to the part taken by certain metals such as manganese, copper and iron in the activity of the oxidases and the peroxidases, and of the suggestive work done

upon the production of artificial oxidases; of the nature and supposed functional importance of the catalases, etc. It would be scarcely possible in fact to enumerate in a brief notice all of the important points which are discussed and reviewed. The author has laid his fellow biologists, who may be concerned in understanding the nature of physiological oxidations, under a debt of gratitude for his able and exhaustive presentation of this difficult subject. We can only wish that with his own extensive first-hand knowledge of the facts he had attempted to winnow from the great mass of contradictory or divergent observations those that to him might seem to be entitled to at least provisional acceptance at the present time. The reader who is not a specialist in this line of work is somewhat at a loss to appreciate how the balance of evidence tends in regard to many of the disputed points.

W. H. Howell

The Evolution of Worlds. By Percival Lowell. Pp. xiii + 262; 12 plates and 56 text cuts. New York, The Macmillan Company. 1909. $2.50 net.

This work is written in the well-known attractive style of the author. It is interesting and will probably fascinate and charm many readers of popular science. Its charm, however, lies in the literary skill of the author, in the attractiveness with which the book is manufactured, in the heavy paper, its clear type and its beautiful illustrations. As a work of art the book is charming and valuable; as an exposition of scientific facts and theories it is exasperating.

The theme of the book is the evolution of the solar system, the process by which the planets came into existence, the phases through which the world has passed, and through which it is destined to pass. Ever since Laplace, in 1796, formulated and published the nebular hypothesis, the subject of the birth, growth and death of worlds has aroused great interest and has attracted many able investigators. For nearly one hundred years the beautiful and simple theory of Laplace was accepted in its entirety by scientific writers. During the last quarter of a century, however, much has been learned concerning the present condition of the solar system, and many facts have been developed which, while establishing the broad underlying idea of planetary evolution, can not be reconciled with the simple Laplacian hypothesis. Sir George Darwin accepted the main outlines of the nebular hypothesis and accounted for the discrepancies between theory and fact by the agency of tidal friction. But there are limits to the potency of tidal friction and even in its modified form the nebular hypothesis fails to account in a satisfactory manner for all the complicated details of the solar system.

Within comparatively recent years Chamberlin and Moulton have advanced what is called the "planetesimal" or "spiral" hypothesis. It explains many of the difficulties encountered by the Laplacian or nebular hypothesis and is undoubtedly the most satisfactory working theory yet advanced. Their first papers were published as early as 1900, since which date they have from time to time elaborated and developed their theory.

Now, Lowell's book, in its main features, is an exposition of the "planetesimal" theory, but an exposition with no reference to, or mention of, the work of Chamberlin or Moulton. It is like the play of Hamlet with Hamlet left out. Neither Chamberlin's nor Moulton's name appears in the index, nor, in a careful reading of the book, do we find any mention of them or of "planetesimal" or "spiral" hypothesis. This is not so strange as at first glance it might appear, for Professor Lowell has recently attacked the scientific value of the theory and the standing of its authors. In the *Atlantic Monthly* for August, 1909, Lowell refers, in a foot note, to Chamberlin and the planetesimal theory in the following words: "Astronomically he is unaware that what prompted his contention, the planetesimal hypothesis, is *mathematically unsound.*" The publication of the "Evolution of Worlds," with its nameless presentation of the planetesimal hypothesis, shows that while Lowell appreciates the fundamental correct-

ness of the theory and its value as a working hypothesis, he is unwilling to admit his former error and to give to true scientific workers the credit which justly belongs to them.

This obvious attempt at consistency on Professor Lowell's part is rather belated, for, as a rule, inconsistencies do not bother him. His books are full of them. He is so interested in marshaling his facts and proving the point at immediate issue, that he appears to forget that at some other time, in some other place, he has arrayed the same facts differently and by them proved the exact opposite. In order to prove, for example, that certain dark lines, which appear in his drawings of Venus, really exist and form permanent markings on this planet, Lowell argues, against the evidence of other investigators, that Venus is surrounded by a very thin atmosphere, "gauze of the most attenuated character"—that the brilliancy of the planet is due to this very thinness of atmosphere. In another chapter Lowell finds the brilliancy of Jupiter and Saturn mostly due to dense cloud forms in their atmospheres. On the one hand, Venus has no clouds because she is bright, while on the other hand, Jupiter and Saturn are bright because of clouds. Again these same markings, or pseudo-markings, on the disc of Venus have been variously described by Lowell in his different papers and books.

The book contains many loose statements of scientific facts and principles, and conclusions are drawn by special pleadings and by apt illustrations rather than by any course of logical reasoning. Yet with all this, and in spite of exaggerations and obvious attempts to create popular excitement, the book gives the general reader, in an attractive form, a more or less accurate conception of the latest ideas in regard to the evolution of our world. It is a pity that the work of such a brilliant writer should be marred by his all too evident faults.

CHAS. LANE POOR

Aerial Navigation of To-day; a Popular Account of the Evolution of Aeronautics. By CHARLES C. TURNER. Philadelphia, J. B. Lippincott Co. 1910. 8vo, pp. 327. Illustrated.

This book, which is one of the few of its kind in the English language, was brought out simultaneously last autumn in this country and in England. Its English author shows his predilection in ways hereafter mentioned, but, while he has made some long balloon voyages he modestly refrains from obtruding them upon the reader, unlike most writers of books upon aeronautics, who usually emphasize the particular subject with which they are most familiar. The reviewer himself is no exception, since in his "Conquest of the Air," a smaller contemporary work, of similar scope to the one under consideration, he gives first place to his own explorations in the element that man has conquered after so long a struggle. Mr. Turner begins with a history of ballooning and the principles involved in both spherical and dirigible balloons, mechanical flight being treated in the same way. There follows a chapter on the aerial ocean, which is a compilation of observations by European aerologists, often without context or sufficient explanation. The remaining chapters discuss the applications of aerial navigation and its possibilities, especially in warfare. Rather out of place is the concluding chapter on typical flying machines and dirigible balloons. "Useful tables," a useless glossary of English and French aeronautical terms and a very inadequate bibliography occupy the remainder of the 321 pages. The book is clearly written, profusely illustrated with pictures and diagrams and gives a good idea of the past history and present status of aeronautics. The sanguine prophecies of its future development recall the extravagant and unrealized hopes which were indulged in when the balloon was invented and render the adage, "never prophesy unless you know," a particularly safe one to follow as regards this new art.

No book of the kind can be entirely free from mistakes, but it would seem that the editor of *Aeronautics,* who read the MS. and, to quote the author, "than whom there is no

better authority," should have perceived a good many errors of omission and commission.

Not even in England do authorities now maintain that Glaisher and Coxwell reached the height of 7 miles, as stated on pages 31 and 160, so that the record of 34,400 feet belongs to Berson and Süring, in Germany, and the balloon "Preussen," holding 300,000 cubic feet of gas, in which they ascended, is much larger than the French "Géant," said on page 33 to be the largest free balloon ever constructed. In the table of long balloon voyages, the distance of 872 miles traveled by Erbslöh and Clayton during the Gordon-Bennett race from St. Louis in 1907 is ignored, although shorter voyages in Europe during the same year are enumerated. There are inaccuracies also in the table of early air-ships, for the speed of the first successful dirigible balloon of Renard and Krebs was 14 miles per hour and not 7½ miles, and Santos-Dumont won the Deutsch prize, by circling the Eiffel Tower, in 1901, and not in 1898. As regards the first mechanical flights it is wrong to say on page 81 that the flights of Farman and Delagrange in 1907–8 "were being eclipsed in America by the Brothers Wright," when the latter had made longer flights several years before. The Malay kite (page 96) is not analogous to the "finbat," since it has no plane projecting at right angles from the middle. Hargrave's kite is correctly described, as is rarely the case, in having no continuous corner sticks which were added by Clayton. The Wright aeroplane does not start on a *declined* rail (page 153). Exceptions can be taken to some of the meteorological conclusions, *e. g.*, that the seasonal and daily changes of temperature are much less at an altitude of 5,000 feet than at the ground, because the contrary has been found by the Blue Hill observations. The statement that an Englishman, Archibald, first used kites to lift automatic registering instruments, on page 158, apparently contradicts one on page 94 that in 1894, for the first time, automatic recording apparatus was sent up on kites from Blue Hill. The last is correct, if instruments recording graphically and continuously, such as are now generally used to obtain observations in the upper air, are meant. Andrée, on his ill-fated north-polar voyage, had two companions, Fränkel and Strindberg, and not three, as said on page 196. It can not be admitted that a projectile fired vertically would fall back with the velocity with which it left the gun, as is asserted on page 213. If dirigible balloons are unable to "tack," like sailing ships (page 226) this is equally true of flying machines. The species of wood suitable for constructing the latter which are named on page 269, have a foreign habitat and none equal the American spruce. In the index, John Wise, the old-time balloonist, is confounded with Lieutenant Wise, the modern kite-experimenter.

The aeronautical achievements are brought down to August, 1909, after Blériot's flight across the Channel had brought home to Englishmen the possibility of aerial invasion, which furnished the psychological moment for publishing this book.

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SCIENTIFIC JOURNALS AND ARTICLES

The March number (volume 16, number 6) of the *Bulletin of the American Mathematical Society* contains: Report of the annual meeting of the society, by F. N. Cole; Report of the winter meeting of the Chicago Section, by H. E. Slaught; Report of the meeting of the American Association, by G. A. Miller; "Shorter notices": Smith's Rara Arithmetica, by L. L. Jackson; Fine and Thompson's Coordinate Geometry, by E. B. Cowley; Boutroux's Fonctions definées par les Equations différentielles du premier Ordre, by C. L. E. Moore; Worms de Romilly's Premiers Principes des Sciences mathématiques, by J. B. Shaw; Auerbach's Taschenbuch für Mathematiker und Physiker, by J. B. Shaw; Laurent's Statistique mathématique, by H. L. Rietz; Duhem's Théorie physique de Platon à Galilée, by E. B. Wilson; Clark's Slide Rule, by F. Cajori; Annuaire du Bureau des Longitudes pour l'An 1910, by E. W. Brown. "Notes on the Institut de France and the annual meeting of the Académie des Sci-

ences," by R. C. Archibald; "Notes"; "New Publications."

THE April number of the *Bulletin* contains: "Simon Newcomb," by E. W. Brown; "A new proof of Weierstrass's theorem concerning the factorization of a power series," by G. A. Bliss; "On some theorems in the Lie theory," by L. D. Ames; "On the discontinuous ζ-groups defined by rational normal curves in a space of n dimensions," by J. W. Young; "A new analytical expression for the number π, and some historical considerations," by G. Vacca; Review of Hermite's Works, Volume II., by James Pierpont; "Shorter notices": Serret-Scheffers, Differential- und Integralrechnung, third edition, Volume III., by A. R. Crathorne; Richter's Kreis und Kugel in senkrechter Projection, by D. D. Leib; Granville's Plane and Spherical Trigonometry, by Jacob Westlund; Lecornu's Dynamique appliquée and Boulanger's Hydraulique générale, by J. B. Shaw; Schafheitlin's Besselsche Funktionen, by A. R. Crathorne. Correction; "Notes"; and "New Publications."

REFLECTIONS ON JOLY'S METHOD OF DETERMINING THE OCEAN'S AGE

As is well known to all geologists, the very important method of estimating the age of the ocean devised by Mr. J. Joly consists substantially in dividing the total sodium content of the sea water by the yearly contribution from the land, this annual tribute being ascertained by analyzing river waters and gauging the streams. It is assumed on uniformitarian principles that what variation there has been in the annual salt tribute is undiscoverable.[1] In a long-forgotten memoir Edmund Halley[2] made a very similar suggestion and anticipated Lyell in propounding a strictly uniformitarian doctrine of the accumulation of salt.

Oceanic sodium is at least chiefly derived from lime-soda feldspars, which as essential constituents are practically confined to Archean and later igneous rocks. The original surface of the earth must have consisted of such rocks to the exclusion of all others, while at the present day the greater part of the land area is covered with sedimentaries. Now the rate of decomposition of rocks is chiefly dependent on exposure. Even in areas of ancient feldspathic massives decomposition does not seem to penetrate to great depths. Thus in the southern Appalachians great areas of gneiss and allied rocks are now covered by a blanket of saprolite (rotten rock in place) which is in many localities 50 feet in thickness, but at all the points where I have observed it less than 100 feet thick. Immediately below the saprolite blanket there is incipient decomposition and the feldspars are milky, but not many yards lower down the feldspars are characteristically translucent and the rock bluish in tint. A layer of decomposition products 100 feet thick seems to arrest decay. Corresponding statements are true of Tertiary volcanics excepting where the decomposition is solfataric. On the other hand Mesozoic and Paleozoic massive rocks deeply buried under sediments are not seldom found to be very free from decomposition. In short, buried massives decompose at a rate which is scarcely sensible.

It is quite conceivable that in the far distant future all the massive rocks might be thoroughly decomposed down to sea level or a trifle below. The continents would then be exclusively detrital. Under such conditions there could be no further important additions to the sodium content of the ocean, for there would then be no leaching, while mere diffusion to any considerable distance is too inordinately slow to produce any noteworthy result even in millions of years.

Thus in the distant past there must have been a time when a far greater mass of massive rock was decomposed each year than now decays in the same period; and a limit to this process can also be foreseen. The total area of exposed massives has surely diminished and will continue to diminish. Climate and temperature may perhaps have been in the past much what they are to-day; the rate of chem-

[1] *Trans. R. S. Dublin*, Vol. 7, 1899, p. 23, and Brit. Assoc. Rep., 1900, p. 369.

[2] SCIENCE, Vol. XXXI., March 25, 1910, p. 459, and *Phil. Trans.*, Vol. 29, 1715, p. 296.

ical denudation per unit area may not have changed considerably, but the most rigid uniformitarian would not maintain that the total area of exposed massive rocks has been constant. The inference seems unavoidable that sodium accumulation is an asymptotic process which progressed more rapidly (though possibly not with greater intensity) in the distant past and will come substantially to an end when a certain very finite layer of surface material has been exhausted. It seems worth while to attempt some rough estimates based on this conception of the saltness of the ocean.

There is a great deal of evidence for the elder Dana's generalization as to the permanence of continental areas. Dana would have been the last to assert absolute invariability of the land area but, just as it seems less hazardous to assume a uniform areal rate of decomposition than any uncertain or fanciful variation of that rate, so it seems safest for the present purpose to suppose the total area constant.

The simplest law compatible with the conditions set forth is that the proportionate decrease in the sodium-producing exposures of massive rocks has been constant. This is of course the familiar compound-interest law. In other words the hypothesis proposed is that the area of exposed sodium-bearing rocks can be represented approximately by the descending exponential which is so characteristic (in Mr. Walcott's words) of cases in which "an entity is subject to gradual extinction or absorption."

If A is the total constant land area and y the exposure of sodium-bearing rocks when the ocean had an age of t years while c is a certain constant to be determined from limiting conditions, then the hypothesis to be examined is

$$y = Ae^{-t/c} \qquad \text{or} \qquad t = c \log A/y.$$

Suppose the total sodium content of the ocean at time t to be N and let my be the increment of N in any one year. Then m being constant

$$N = \int_0^t mydt = Amc(1 - y/A).$$

Here N is pretty well known, and so is A, or at least its present value, while m and the value of y for the present time are known to a certain degree of approximation. Hence c can be found. If t were infinite, y would become zero, and therefore Amc represents the total sodium which can possibly be supplied to the ocean if the hypothesis fits the case. From this total it is easy to compute the thickness of the layer of average massive rock which would yield it.

Mr. Joly's assumption expressed in this notation is that, subject to minor corrections,[3] the age t would be given by N/my. His data are

$$N = 14{,}694 \times 10^{12} \quad \text{and} \quad my = 155.42 \times 10^{6}$$

tonnes (or metric tons) and I shall adopt the same values in order to obtain strictly comparable results. The ratio N/my is 94.544×10^{6}.

A careful study of the areas of exposure of the principal geological formations was made by the late distinguished physical geographer Lieutenant-General Alexis von Tillo. This includes the Archean and the younger eruptives, the results being expressed in hundredths of the total surveyed area. The following is an extract from von Tillo's table.[4]

Continent	Archean	Eruptives	Total
Europe	20.6	1.3	21.9
Asia	17.7	4.7	22.4
Africa	18.4	2.2	20.6
Oceanica	20.0	4.8	24.8
North America	27.2	5.5	32.7
South America	18.7	4.6	23.3
Mean	20.3	4.0	24.3

The most recent geological map of North America (compiled by Mr. Bailey Willis) shows that the relative area of exposed feldspathic rocks on this continent is not so large as was supposed when von Tillo wrote, and, though I have made no minute measurements, this exposure as now mapped seems not to exceed 25 per cent. With this emendation von Tillo's table shows a truly remarkable uni-

[3] Especially for marine denudation and uncertainty in the volume of the ocean.

[4] *Comptes Rendus*, Paris, Vol. 114, 1892, pp. 246, 967.

formity throughout the world, all the figures lying between a fourth and a fifth of the total area. He too was impressed by the smallness of the variation in the relative areas of Archean exposures.

It seems well established that at the present day the relative area of y/A lies between two tenths and three tenths. The values for the constant c, the ultimate sodium accumulation, Amc, and the present age, t, as computed from the formula are given in the following table for these extremes and also for $y/A = 1/4$.

y/A	0.20	0.25	0.30
c	23.636×10^6	31.515×10^6	40.519×10^6
Amc	N 5/4	N 4/3	N 10/7
t	38.0×10^6	43.7×10^6	48.8×10^6

It can also be computed from the formulas at what rate the area of massive rocks is diminishing. This is expressed by $dy/dt = -y/c$. Substituting for y its value in terms of A and taking A at 134.38×10^6 square kilometers gives the mean annual net decrement for each of the three cases at almost exactly one square kilometer in spite of additions due to vulcanism, a result which is certainly not startling.

Mr. F. W. Clarke[5] has shown that a shell of average igneous rock enveloping the globe and 2,225 feet (678.2 meters) thick would furnish all the salt of the ocean. The ultimate thickness of the decomposed shells corresponding to the three values of y/A would be proportional to Amc, that is, 848, 904 and 969 meters, respectively, so that Clarke's shell would never assume improbable dimensions, or exceed three fifths of a mile.

Much the weakest point in this speculation seems to me to be the assumed constancy of the land area. This has assuredly fluctuated, yet when shallow seas flooded portions of the continents, marine denudation took the place of erosion in part, at least, and was possibly an equivalent. A is taken as constant only because there seems no way at present in which its variations can be rationally represented. The present marine denudation is offset to some extent by wind-borne or cyclic salt. It seems to me needless to consider the sodium content of sedimentaries as a source of supply for the ocean. Limestones contain a mere trace of sodium. Shales—which are the prevalent detrital rocks—(including clay, clay-slate and phyllite) contain sodium, but seemingly in a stable form, since ancient phyllites and modern clays are indistinguishable by their sodium content. Sandstones do not contain enough sodium to affect the problem of the earth's age, considering the greater uncertainties. Possibly some massives underlying thin layers of sedimentaries yield a little sodium, but, per contra, areas properly mapped as Archean or massive are in many localities protected by saprolite. This is true locally even in glaciated Alaska. Considering such protection, I believe the effective value of y/A to be nearer a fifth than a quarter.

Possibly it may be worth while to refer to the evident fact that if the descending exponential properly represents the history of the accumulation of sodium in the ocean, this became highly saline much earlier than on Mr. Joly's theory. Thus when the earth was half its present age the law of linear increment would of course imply that there was half as much salt in the ocean as there is now, while if the exponential relation holds good and $y = A/5$, the ocean at that epoch contained seven tenths of the present amount. The fauna of the Paleozoic indicates a salt-water habitat. If the deep was then as briny as it now is, it must have taken in a vast amount of juvenile water in the mean time on either hypothesis.

The annual increment of N or the quantity here called my is susceptible of improved determination, as every one has recognized. Mr. Clarke is now engaged on a discussion of this subject based on far more extensive material than was at Mr. Joly's disposal, and his results will be available in a few months. When they are known, it will take only a few minutes to recompute the age of the earth on the hypothesis here discussed.

The foregoing speculation is based on the assumption that the area of sodiferous rocks has diminished by a constant proportion $(1/c)$

[5] "Data of Geochemistry," 1908, p. 28.

per unit of time—about a thirty-millionth part each year. This can not be precisely true, but I think it must be a better approximation than the hypothesis that this area has undergone no diminution at all. The results may err in either direction. Thus the rate of diminution may fluctuate; if it is now above the average the exponential relation would give too low a value for the earth's age, and *vice versa*. Whether the rate is actually above or below the average we have no means of discovering. Again it is wholly improbable that either intensity of decomposition or the average yield of sodium per square kilometer of sodiferous rocks has always been the same, and this yield may now exceed the mean or fall short of it.

It appears that Mr. Joly's linear relation between oceanic sodium and its increment must lead to an excessive estimate of the earth's age, at least when the increment is duly determined. Thus that method assigns a limit, a knowledge of which is very valuable as a check on other computations. On the other hand, the ages computed from his data by the exponential expression seem to me suspiciously low. Various trains of reasoning lead me, at least, to believe that 50 million years is not a maximum but a minimum age; if so and if the exponential hypothesis is applicable then Mr. Joly's datum for the annual sodium increment is too large.

George F. Becker

Washington, D. C.,
February 26, 1910

BOTANICAL NOTES

RECENT STUDIES OF THE FUNGI

Dr. J. J. Davis's "Fourth Supplementary List of Parasitic Fungi of Wisconsin" in the *Transactions of the Wisconsin Academy of Sciences, Arts and Letters* adds many new hosts, many species not hitherto reported, and some species new to science. All of the latter are Fungi Imperfecti. With this may be noticed the same author's "Mycological Narrative of a Brief Journey through the Pacific Northwest" (in the same *Transactions*) in which we are reminded of the itineraries of the earlier botanists, like Kalm and Pursch, or even the master traveling botanist, Linné, in which not only are we told of the plants observed and collected, but we are made delightfully aware of the botanist himself. Our younger botanists might profitably study the style of the paper before us.

In these days when all lichens are fungi, we may notice here L. W. Riddle's "Key to the Species and Principal Varieties of Cladonia occurring in New England," which appeared in *Rhodora* for November, 1909. It looks promising, and no doubt will be helpful to students.

Of quite a different nature is Professor Atkinson's paper on "Some Problems in the Evolution of the Lower Fungi," published in *Annales Mycologici*, 1909. It was first delivered as the presidential address before the Botanical Society of America. In a most ingenious manner the author argues for the origin of the Phycomycetes from the lower unicellular algae such as the Protococcoideae through Chytridiales, to Saprolegniales, etc. He discusses the "degenerative influence of parasitism" and comes to the conclusion that "there seems little in support of the theory." On the contrary, he builds up "a natural series from Chytridiales to the Oomycetes and Zygomycetes, showing progressive evolution of the vegetable body and sexual process." While the paper may not be conclusive, it is suggestive and should be read by every student of the lower fungi.

W. H. Brown, in a note on "Nuclear Phenomena in *Pyronema confluens*" in the Johns Hopkins University Circular, 1909, points out that "it seems probable that the fusion of the sexual nuclei originally took place in the ascogonium, but later was delayed until some point in the development of the ascogenous hyphae." In this way he suggests a reason for the disappearance of the functional sexual organs in many fungi.

Here may be mentioned several papers on the economic aspects of certain parasitic fungi; namely, H. T. Güssow's "Serious Potato Disease occurring in Newfoundland" (Bull. 63, Canadian Dept. Agric.), in which a

species of *Chrysophlyctis* is shown to be the cause of a canker of the tubers which has been very destructive in Europe and has now appeared in Newfoundland. It produces rough nodules which emerge from the "eyes" and enlarge and spread over the surface of the tubers. So too the botanist will find much of interest in R. E. Smith's "Report of the Plant Pathologist" in Bull. 203 of the California Experiment Station, including as it does discussions of pear blight, walnut blight, apricot diseases, brown rot, etc., with a list of plant diseases additional to those previously reported. One of the most useful of recent papers on plant diseases is Professor Heald's "Symptoms of Disease in Plants" in Bull. 135 of the University of Texas. While ostensibly addressed to "persons engaged in general farming," it will prove to be one of the most useful introductions to plant pathology available for the young botanist. Here in an orderly sequence the principal aspects of plant diseases are brought before the reader in a lucid text aided by excellent photographs which have been well reproduced in "halftones." If the author would make an index to this paper, and have it cheaply bound it would be an excellent little book (of about 65 pages) for use in the classes in agriculture in the high schools.

NOMENCLATURE OF THE FUNGI

A YEAR ago twenty-six prominent American students of the fungi formulated "Motions for Additional Articles Relating to the Nomenclature of the Fungi to be presented at the International Botanical Congress at Brussels in May of the present year." The motions advocate (A) beginning mycological nomenclature with the "Systema Mycologicum" of Fries, 1821–1832; (B) the interpretation of the Friesian "tribes" of *Agaricus* as genera in the modern sense; (C) the making of a list of *genera fungorum conservanda,* in spite of the law of priority; (D) the application of the present rules as to generic names of monomorphic fungi; (E) the recognition and retention of the generic names of the "perfect form" of the pleomorphic fungi; (F) the application of the present rules as to specific names of monomorphic fungi; (G) the recognition and retention of the specific names of the "perfect form" of the pleomorphic fungi, with certain modifying provisions. It is further "recommended" that authors add figures to their diagnoses; that they conform to Recommendations VIII.–XIV. of the Vienna Code; that they indicate type species in genera.

Quite recently there has come to hand a paper by Professor W. G. Farlow, entitled "A Consideration of the Species Plantarum of Linnaeus as a Basis for the Starting Point of the Nomenclature of Cryptogams," which shows conclusively the inadvisability of using the Linnaean work, for the fungi at any rate. While he does not pronounce definitely upon the matter, he shows some very good reasons for preferring the "Systema Mycologicum" of Fries. In passing he throws the weight of his authority in favor of a list of *genera conservanda,* saying "there is nothing illogical in this, and practically there are great advantages."

From the foregoing it may be fairly predicted what will be the outcome of the Brussels Congress, and for the most part it seems good to the present writer, who, while not daring to hope for a perfectly satisfactory code, is ready to accept the best that can be made now, while still hoping for its betterment in future congresses.

DESCRIPTIVE BOTANY OF THE FLOWERING PLANTS

DR. MILLSPAUGH continues in Publication 136 of the Field Columbian Museum his "Praenuciae Bahamenses," this being No. II., and including a map of the Bahaman Archipelago, a list of the collectors, observations and descriptions of new species (the latter in Latin!), a list of native plant names, and an index to I. and II. From the index we learn that in the two parts three new genera and fifty-three new species or new combinations have been described.

J. N. Rose and J. A. Purpus describe "Three New Species of *Echeveria* from Southern Mexico" in the Contributions from

the U. S. National Herbarium (Vol. 13, pt. 2) illustrating the paper by five fine photographs.

Professor Aven Nelson's "Contributions from the Rocky Mountain Herbarium," VIII. (*Bot. Gaz.*, XLVII.), includes many new species from the deserts of southern Nevada and adjacent Arizona, collected by L. N. Goodding in 1905.

Dr. E. L. Greene has taken time enough from his historical studies to bring out a number of descriptive or critical papers, among which are "New Californian Asteraceae," "Some Western Caulescent Violets," "Two New Southern Violets," etc., in his Leaflets of Botanical Observation and Criticism (Vol. II.); and "Some Thalictra from North Dakota" in the *Midland Naturalist* (October, 1909). Three new species are described.

Professor W. L. Jepson's "Synopsis of the North American Godetias" (University of California Publications, Vol. 2, No. 16) is a careful and exhaustive study of the species of this Pacific coast genus. Seventeen species are recognized, of which six are new. A helpful plate accompanies the paper.

Another paper on cactuses—"Cactaceae of Northeastern and Central Mexico," by W. E. Safford (Smithsonian Report for 1908), adds materially to our knowledge of these interesting plants. The first twenty pages are devoted to a general discussion of the structure, morphology and classification of the cactuses at large, while the remaining eighteen pages are given to a synopsis of Mexican Cactaceae. Fifteen fine plates and twenty-four text figures make this a valuable paper for any one who wishes to learn about the Cactaceae.

Here we may briefly mention Professor Schaffner's "Pteridophytes of Ohio," which is in reality an excellent local manual of these plants; Professor Shimek's "Flora of Winneshiek County" (Iowa), being a useful annotated list, with ecological discussions; Professor L. H. Harvey's "Floristic Composition of the Vascular Flora of Mount Ktaadn, Maine," with analytic tables and discussions; and lastly Professor Ruth Marshall's "Vegetation of Twin Island" giving the results of several summers' studies of a small island in Lake Spooner in northwestern Wisconsin. It contains a suggestion as to what may be accomplished scientifically while having a good outing.

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Special Articles

The Sex-Determining Chromosomes in Ascaris

In 1908 Professor Boveri observed in an especially large number of the fertilized eggs of *Ascaris megalocephala bivalens,* a small chromatin element which he had already previously seen, and thinking that it might be a sex chromosome, he suggested to Miss Boring that she should make an exact study of the chromatin conditions in this species. Though Miss Boring obtained important results,[1] she could not arrive at any positive conclusion concerning the significance of this element. In an appendix to Miss Boring's paper (*l. c.*), Professor Boveri concludes that this small chromosome in *Ascaris megalocephala* is a sex-determinant, and also reports the finding by himself and Gulick, of a heterochromosome in *Heterakis,* which behaves exactly like the heterochromosome in some hemiptera (type *Protenor,* of Wilson).

Following the suggestion of Professor Boveri, I have worked upon the spermatogenesis of *Ascaris megalocephala* and *Ascaris lumbricoides.* In the maturation divisions of the spermatogenesis of *Ascaris megalocephala,* which have been very accurately investigated by O. Hertwig and Braur, and also by Miss Boring, nothing has been observed hitherto of an independent chromatin element that could be interpreted as a heterochromosome. Boveri (*l. c.*) has offered as an explanation for this condition, that the heterochromosome here may be united with one of the large chromosomes. Studying a great number of males of *Ascaris megalocephala,* I have found one in which an independent heterochromosome can be followed throughout the whole maturation period and another in which it is present in

[1] *Archiv f. Zellforschung,* V. 4.

the primary spermatocytes. The heterochromosome in the vesicular nucleus of the primary spermatocytes is a small element composed of two halves lying to one side of the two tetrads. In the first maturation division the two halves of the heterochromosome are distributed to the two daughter cells and in the second maturation division, the now simple heterochromosome passes over undivided to one spermatid. So one half of the spermatozoa contain the well-known two rod-formed elements, while the remaining spermatozoa possess in addition to the two large chromosomes, the small heterochromosome. There can be scarcely any doubt that this element is identical with the "small chromosome" described by Miss Boring for a part of the fertilized eggs.

In *Ascaris lumbricoides* I have found the sex-determinant in the form of a group of five univalent chromosomes passing undivided to one daughter cell in the first maturation division so that one half of the secondary spermatocytes, and consequently one half of the spermatozoa, have 19, the other half, 24, chromosomes. This type has some similarity with that of *Gelastocoris* described by Payne,[2] but differs from it in this respect that in *Ascaris lumbricoides* all five constituents of the group go to one daughter-cell.

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THE AMERICAN FEDERATION OF THE TEACHERS OF THE MATHEMATICAL AND NATURAL SCIENCES

THE annual meeting of the council of the American Federation was held on Monday, December 27, 1909, at the Massachusetts Institute of Technology in Boston, Mass. There were twenty-two representatives of eight associations present. The report of the executive committee showed that six associations had joined the federation during the past year. The total number of paid-up members in the associations that belong to the federation now amounts to 2,040.

Reports were presented from the local associations showing activity and progressive work in all.

The committee on bibliography of science teaching reported that its work was completed and urged the federation to get the bibliography printed as soon as possible.

The committee on a syllabus in geometry reported that work was well under way. The committee has been divided into three sub-committees, one on logical considerations, one on lists of basal theorems and one on exercises and applications. The committee expects to have its work completed during the coming year.

The committee on college entrance requirements had gathered a large amount of information which showed the great variation in the requirements of the different colleges and showed that it was impossible for any school to meet them all. The committee recommended that the federation take up this matter with the College Entrance Examination Board and see what can be done toward bringing about uniformity. The report was accepted as a report of progress and the committee continued and urged to carry on the work.

The committee on publication recommended that the federation publish its reports in *School Science and Mathematics* and such other journals as would accept them and urged that the local associations send their reports of their meetings to *School Science and Mathematics* promptly and regularly. The report was accepted as a report of progress and the committee continued.

The New England Association of Chemistry Teachers presented a request that the federation appoint a committee to make suggestions for changes in the definition of the requirement in chemistry and that the federation should bring this matter to the attention of the College Entrance Examination Board. The request was approved.

A letter from the College Entrance Examination Board asked cooperation of the federation in determining what form of logarithm tables were best to study for examination purposes. It was voted that a committee be appointed by the chair in accordance with the wishes of the college board.

The question of the publication of a journal for mathematics alone was discussed at some length and it was voted that a committee be appointed to consider this question and report at the next meeting.

Informal reports of progress were presented by members of the International Commission on Teaching of Mathematics.

The nominating committee reported nominations

[2] *Biol. Bull.*, V. 14, 1908.

for the coming year, and these officers were unanimously elected:

President—C. R. Mann, University of Chicago.

Secretary-Treasurer—Eugene R. Smith, Brooklyn Polytechnic Institute.

Members of the Executive Committee—J. T. Rorer, William Penn High School, Philadelphia; W. Segerblom, Phillips Exeter Academy; I. N. Mitchell, State Normal School, Milwaukee, Wis.

Professor C. H. Judd, of the University of Chicago, addressed the federation on the topic, "Scientific Experimental Investigation of Education." The speaker indicated that opinions concerning education were usually based upon rather vague and uncertain data. He urged that problems in education were capable of solution by scientific experiment and that they should be solved in that way. Several experiments were presented as types which might be followed.

Mr. H. R. Linville, of Jamaica, N. Y., presented an address on "Old and New Ideals in Biology."

The meeting adjourned subject to the call of the executive committee.

C. R. Mann,
Secretary

THE AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

The twenty-second annual meeting of the American Association of Economic Entomologists was held at the Harvard Medical School (Brookline), Boston, Mass., December 28 and 29, 1909. The first session was called to order by President W. E. Britton, of New Haven, Conn., who presided throughout the meeting, and who delivered the annual address on "The Official Entomologist and the Farmer." The program was crowded with papers which were of great economic importance to the entomologist and the agriculturist, although a few were more technical in character and dealt with some of the fundamental principles of scientific investigation of entomological matters. A discussion of different methods used in research work was of particular interest, as were also the reports of the progress that is being made in the field and parasite work in New England for the purpose of controlling the gypsy and brown-tail moths. A report by Dr. W. P. Headden, of Colorado, concerning the injury to fruit trees caused by arsenical spraying and the discussions that followed brought out many new ideas on this important subject. An exhibit made by the local entomologists and members which was held in an adjoining room contained samples of apparatus and breeding devices, as well as insect collections, which added much interest to the meeting. On Tuesday evening the association and the Entomological Society of America were the guests of the Cambridge Entomological Club and on Thursday morning the members had the opportunity of witnessing a spraying demonstration at Arlington with high power sprayers, as the guests of Mr. H. L. Frost.

The attendance at each session numbered over 100 members and visitors, nearly every section of the United States and Canada being represented.

The association commended the work which is being done to control the gypsy and brown-tail moths in New England, endorsed the bill before Congress to provide for the establishment of standards of purity of insecticides and fungicides and advocated the passage by Congress of a national law to prevent the importation of dangerously injurious insects and fungus diseases from foreign countries.

The report of the secretary showed that the association was increasing in membership and was in good financial condition. The *Journal of Economic Entomology*, which is the official organ of the association, was also reported by the business manager to be in a thriving condition.

The following officers were elected for the ensuing year:

President—Professor E. D. Sanderson, Durham, N. H.

First Vice-president—Dr. H. T. Fernald, Amherst, Mass.

Second Vice-president—Professor P. J. Parrott, Geneva, N. Y.

Secretary—A. F. Burgess, Washington, D. C.

SOCIETIES AND ACADEMIES

THE GEOLOGICAL SOCIETY OF WASHINGTON

At the 226th meeting of the society, held at the George Washington University on Wednesday, January 26, 1910, Mr. Edson S. Bastin informally exhibited specimens of pegmatites whose quartzes had been tested by Messrs. Wright and Larsen.

Regular Program

Some Pegmatites from Southern California: W. T. Schaller.

The pegmatites of Southern California which have been exploited for their valuable gem minerals (tourmaline, spodumene, etc.) are granitic rock bodies filling fissures in gabbro. Many of these bodies consist of two parts of approximately equal thickness—namely, an upper coarse granite and a lower fine-grained banded garnet aplite.

The lithium and gem minerals occur in the bottom of the upper part and consequently near the center of the entire body. A number of distinct structural varieties of pegmatite may be recognized, all formed by vein processes.

The Cobalt Mining District of Ontario: Mr. S. F. EMMONS.

The features of the Cobalt silver deposits that most strikingly differentiate them from those of most mining districts are:

Mineralogically, the predominance of the metals cobalt, nickel, silver and bismuth, with an almost total absence of lead and zinc, and their prevalent combination with arsenic and antimony rather than with sulphur.

Structurally, the extreme narrowness of all the rock fractures, and the general absence of evidence of any considerable displacement such as is afforded by slickensides or clay selvages. Nevertheless, very decided proof exists that the veins are true fault fractures, not contraction cracks, in that they contain dragged-in fragments of wall rock, that they pass uninterruptedly from one rock formation to another, even though separated by a great unconformity, and that in the coarse so-called conglomerate, in which they were first discovered, they cut through matrix and included fragments indifferently. They seem to be fractures that have been produced under so great a load of overlying rocks that movement had been greatly restricted.

Genetically, the predominance of silver in the metallic state over its combinations with sulphur, arsenic and antimony; and the remarkably abrupt falling off in the tenor of this metal from the bonanza zone, where it is measured by thousands of ounces per ton, to the ordinary low-grade cobalt vein with less than ten ounces, a change that takes place within very few feet.

These facts seem best explained on the assumption that the present veins are only the roots of veins that were originally of great vertical extent but have been mostly worn away; and that these remaining vein roots have been gradually enriched by successive leachings-back for unusually long geological periods (for both primary and secondary vein fractures are of pre-Cambrian age).

The secondary fractures within the veins that carry the most of the silver are probably not the channels through which the silver was originally introduced, but simply those which, by the admission of solutions leached down from the surface, have produced an extraordinary enrichment in this metal.

The conclusion seems warranted, therefore, that the rich silver veins are not, as was originally assumed, confined to any particular formation, and that while the bonanza portion of individual veins has a limited extent in depth, the abundance of small fractures or calcite veins, that may at any time pass into bonanza, renders the future of the district very promising.

The Mechanical Part of a Paleontologic Monograph: LANCASTER D. BURLING.

The value of a monograph depends so largely upon the accessibility of the material which it contains that current methods are believed to be inadequate for the proper presentation of the results of careful research. Some improvement in the monographic treatment of paleontologic subjects may be accomplished by the introduction of the following features. They should be regarded as merely an initial step in what is believed should be a general attempt to raise the standard of monographic methods.

1. A list giving the present reference of every generic or specific name occurring in the synonymy, arranged alphabetically by specific as well as generic and subgeneric terms.

2. Detailed localities with locality numbers (original where possible or arbitrary where taken from the literature) and a list of the localities giving them in detail (with reference to published sections if possible) and citing the included species.

3. Sections typical of each general area or province covered by the monograph, giving in one column the species occurring in the section and in a second the species occurring elsewhere throughout the larger area in their approximate stratigraphic position; tables, arranged by faunal provinces, showing at a glance the species occurring in the major subdivisions of each; and summary tables showing the general geographic and stratigraphic distribution of the species, the genera and the families, respectively.

4. Descriptive notes indicating the source from which all or any part of each reference in the synonymy may have been copied, or the place in which any part of it may be duplicated, etc., and supplementary foot-notes under each genus giving a chronologic list (with references) of the various genera to which the species now placed in the genus have been referred.

5. Complete descriptions of plates naming the type specimens, giving the locality and catalogue numbers, and outlining a complete history of each previously figured specimen.

6. A separate bibliography, list of localities and index appropriate to the volume of plates when a separate volume is necessary, both indexes being arranged under the specific as well as the generic names.

EDSON S. BASTIN,
Secretary

AT the 227th meeting of the society, held at the George Washington University on Wednesday, February 9, 1910, under informal communications, Mr. David White exhibited several lantern slides prepared by the Lumière Company, showing in their natural colors the organic remains found in coals. The sections used for this trial were about seven microns in thickness and embraced cannel coals from Lesley, Ky., and Calloway County, Mo., and a brown xyloid lignite from Lehigh, N. D.

Mr. François E. Matthes described the site of an extinct waterfall in the Yosemite Valley, still conspicuous in the configuration of its north wall. The waterfall was existent only during glacial times, when the glacier in the hanging valley of Yosemite Creek sent a lobe up into the basin now known as the Eagle Peak Meadows. From the front of this lobe several streams coursed toward the canyon rim, converging near the edge and plunging over in several places but a few hundred feet apart. The cliff below receded under the action of the falls, and a marked horseshoe-shaped reentrant resulted. It is over the débris at the foot of the fall site that the lower zigzags of the Yosemite Falls trail are laid.

Regular Program

Coal-mining and Coke-making at Dawson, New Mexico: Mr. E. W. PARKER.

The plant of the Stag Canyon Fuel Company, which represents one of the highest types of coal-mining development in the United States, is located at Dawson, Colfax County, N. M., in Ts. 28 and 29 N., R. 20 E., and T. 28 N., R. 21 E. The coal property embraces part of the Raton Mountain region, and includes operations in and about Trinidad, Col., and Raton, Koehler, Van Houten and Dawson, N. M. There are two workable beds in the field, only one of which is being mined at the present time. The Dawson mines are on the lower of the two workable seams, known as the Raton or Blossburg bed. It lies nearly level and varies from 6 to 11 feet thick, with an average of about 7 feet.

The mining company is a subsidiary organization of the Phelps-Dodge interests, of Philadelphia, and the idealistic character of the plant is due to the beneficent influence of Dr. James Douglas, the president of the company, and to the administrative genius of Mr. E. L. Carpenter, its general manager.

The mining methods of the company, and the arrangements for handling the coal and preparing it for the coke ovens, are strictly modern throughout. Instead of the ordinary bee-hive coke ovens, modified underflue ovens are employed by which the gases from the coking operations are used for heating the ovens and also for generating the power used in the operation of the mines, the heating of the office, and other company-buildings, and for furnishing electric light to the town. Not a pound of coal is used in the power plant, which is a model of neatness and efficiency. Special provisions are made for the safety of the miners and other employees, and no shot-firing is done while any of the miners are within the mines. Careful supervision is exercised over the methods of undercutting and shearing coal and of placing shots, in order to avoid any possibility of windy or blown-out shots. A checking system is employed by which it is known that all employees are out of the mines before the shot-firers enter. The shot-firers make the electric connections, and after they have left the mines, the entrances are closed by iron gates and a red light is exposed in front of each gate in order to warn persons away and thus avoid accidents from flying débris, in case an explosion should occur.

The Stag Canyon Company further trains its men in first-aid-to-the-injured work; conducts a rescue station in which men are instructed in the handling of rescue apparatus, and a hospital service, provided for the employees at a minimum expense.

The Distribution of Platinum in the United States: Mr. DAVID T. DAY.

While recent high prices have caused active search for platinum, showing it to be rather widely distributed in many rocks, useful accumulations in the United States are at present limited to the Rambler mine, in southern Wyoming, and the Key West group of mines in Bunkerville, near eastern Nevada, and to about seven important groups of accumulations in connection with placer mines of the Pacific Slope. Most platinum was produced last year from the neighborhood of Oroville, Cal., where it occurs about in the proportion of 1 to 500 of gold. The proportion has not been determined for Trinity County, Cal., and Josephine County, Ore., the other two inland

localities. On the coast, platinum is found in the proportion of 2 to 1 of gold, near Surf, Santa Barbara County, but other places in the same region, including San Luis Obispo, show only 1 to 20 or 1 to 50 of gold.

The next important group of accumulations is found near Trinidad Head, Humboldt County, Cal., another at Crescent City, Cal., at the mouth of Smith River, Ore., and one on the South Fork of Smith River. The most important group of all extends from the mouth of Rogue River north to Coquille River. At Cape Blanco an accumulation of platinum has been found where that metal is five times as abundant as the gold. On the west coast of Washington platinum is comparatively abundant in the proportion of 1 to 10 and 1 to 15 of gold.

The Half Dome of the Yosemite Valley: Mr. FRANÇOIS E. MATTHES.

The Half Dome, like the other domes of the Yosemite region, represents a huge granite monolith that has survived the reduction of the more fissile rocks about it by virtue of the superior resistance to disintegration of its undivided mass. It is unique in that its dome form is a partial or incomplete one, being abruptly trenched on the northwest by a straight and sheer cliff face 2,000 feet in height. The curving back and sides are entirely normal, having evidently evolved through progressive exfoliation, like the bulbous exteriors of all domes. Their smooth, sweeping curves are indicative of maturity; for it is only through long-continued shelling that a monolith of irregular shape is reduced to a continuously rounded mass. At the same time, the prevailing flatness of the back and its trend, parallel with the northeast-southwest system of joints, prominent throughout the region, are clearly inherited from the structure planes that originally bounded the monolith on that side.

For the origin of the sheer front of the dome, three alternative hypotheses have been advanced:

1. The present mass is a true half dome—that is, a remnant of a much larger monolith, the other portion of which has caved off, perhaps owing to glacial undercutting in the Tenaya trough.

2. The monolith extended originally but little farther to the northwest, and has suffered reduction on that side, as on the other sides, merely through normal exfoliation. Only, the shells on the northwest side were plane instead of curved, because the initial bounding surface was plane.

3. The present front coincides essentially with the plane fissure that from the first constituted the boundary of the monolith, and has only comparatively recently been exposed through the rapid scaling off of the thin plates of a zone of vertically sheeted rock.

The first hypothesis seems inadmissible, inasmuch as massive granites inherently break off by conchoidal fractures and not by plane fractures of the magnitude of the dome front. The second hypothesis finds some support in the overhanging shells on the top of the dome, for these plainly indicate the former extension of the monolith for a short distance to the northwest. The existence, however, of a great mass of plates clinging to the northeast end of the cliff face in the form of a conspicuous shoulder, together with the strongly accentuated fracture that separates them from the body of the monolith proper, is held to demonstrate conclusively that the monolith never did extend beyond its present front, but was actually bounded there by a zone of thinly sheeted rock. Only toward the top of the front has exfoliation set in and commenced its rounding off process (under the overhang), as is patent from the profile view of the dome obtained from the Quarter Domes.

FRANÇOIS E. MATTHES,
Secretary

THE BIOLOGICAL SOCIETY OF WASHINGTON

THE 467th regular meeting of the society was held March 5, 1910, in the west hall of George Washington University, President T. S. Palmer in the chair.

The following communications were presented:

Remarks on a Restoration of Basilosaurus cetoides: J. W. GIDLEY.

Remains of this species were first discovered in Alabama in 1834 and Harlan applied to it its present generic name. Owen, in 1839, recognized its mammalian character and renamed it *Zeuglodon*. The present restoration is based on portions of two individuals, one of which furnishes the anterior and the other the posterior part of the animal. The restoration is almost complete. This mammal is somewhat distantly related to the whales. It has a total length of about 35 feet and a skull 5 feet long.

The Stridulations of some Katydids: H. A. ALLARD. (Read by the recording secretary.)

The author studied the stridulations of several members of the Locustidæ at Thompson's Mills, Ga., and at Plummer's Island, on the Potomac, above Washington City. The peculiar noises made by the following species were studied:

Scudderia texensis, S. furcata, Amblycorypha oblongifolia, A. rotundifolia, A. uhleri, Microcentrum retinerve, M. rhombifolium and *Cyrtophyllus perspicillatus*. The last is the true katydid, and has harsher notes than any of the others named. Photographs were exhibited showing several of these species in the act of stridulation.

Japanese Goldfish: Hugh M. Smith.

Dr. Smith exhibited water-color paintings of the ten varieties of goldfish now known and cultivated in Japan, and discussed some of the biological points connected with the goldfish and its culture. The goldfish is grown more extensively in Japan than elsewhere; and in no other country is any purely ornamental animal maintained by a larger proportion of the population. This fish has been a favorite subject for biological study in Japan; and being exceedingly plastic material it has yielded surprises to the biologist as well as the culturist.

The goldfish, like various other things now firmly established in Japan, came originally from China, the first known importation of the cultivated fish being in the year 1500. The original stock has been greatly improved by cultivation and crossing, and is now superior to any of the Chinese breeds. The goldfish was probably not indigenous to Japan and the wild, plain-colored form there found represents a reversion.

Attention was called to the views and theories of Ryder (1893): (1) that the Japanese varieties of goldfish are the most profoundly modified of any known domesticated animal organisms; (2) that the greatly enlarged fins are correlated with a degeneration of the muscular system through disuse, owing to the "continued restraint of the fish in small aquaria through many generations"; (3) that the feeble swimming powers have been "purposely cultivated by oriental fish fanciers," and the energy that would have gone into motion has reacted in the growth of fins; (4) that the enlarged caudal and other fins may serve as supplemental respiratory organs; and (5) that this hypertrophy has been "developed in physiological response to artificial conditions of respiration in the restricted and badly aerated tanks and aquaria in which the fish have been bred for centuries."

As the salient feature of goldfish culture in Japan has always been the perfect oxygenation of the water in the rearing ponds, the speaker held that any theories based on the assumption of lack of aeration are untenable.

The most remarkable morphological features of Japanese goldfish are the elimination of the dorsal fin and the development of paired caudal and anal fins in some varieties. The division of the caudal is not merely a splitting of the superficial soft parts, but represents an actual bilateral separation of the deep-seated bony elements from which the fin arises.

The first and the last of these communications were discussed by Dr. Theodore Gill, Dr. T. S. Palmer and others.

D. E. Lantz,
Recording Secretary

THE AMERICAN CHEMICAL SOCIETY
NEW YORK SECTION

The sixth regular meeting of the session of 1909–10 was held at the Chemists' Club on March 11.

The following officers were elected for the session of 1910–11:

Chairman—Chas. Baskerville.

Vice-Chairman—Samuel A. Tucker.

Secretary and Treasurer—C. M. Joyce.

Executive Committee—Morris Loeb, G. W. Thompson, J. E. Crane and Arthur E. Hill.

The papers presented were as follows: Wm. C. Ferguson, "The Determination of Copper in Blister and Refined Copper"; Chas. Baskerville, "Scrubbing Device for Vacuum System in the Laboratory"; J. L. Sporer, "Rack for Holding Reagents in Bulk"; H. T. Beans, "A Constant Temperature Drying Oven and Gas Regulator"; S. H. Beard, "An Automatic Pipette"; C. T. G. Rogers, "Description of a Modified Pettersson and Palmquist Apparatus for the Determination of Carbon Dioxide."

C. M. Joyce,
Secretary

THE CHEMICAL SOCIETY OF WASHINGTON

The 197th meeting was held in the Public Library on Thursday evening, March 10. President Failyer presided, the attendance being 52. The annual smoker will be held on April 9. The committee on communications was authorized to confer with the committee of the Washington Academy of Science in preparing programs for joint meetings. Dr. W. D. Bigelow, who had general charge of the construction of the new bureau of chemistry building, presented the only paper of the evening, viz., "The Construction and Equipment of a Chemical Laboratory." The paper was illustrated with lantern slides.

J. A. LeClerc,
Secretary